United States Department of Agriculture

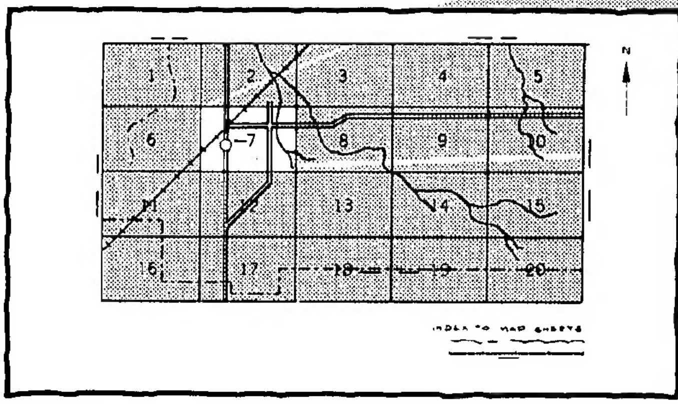
Soil Conservation Service

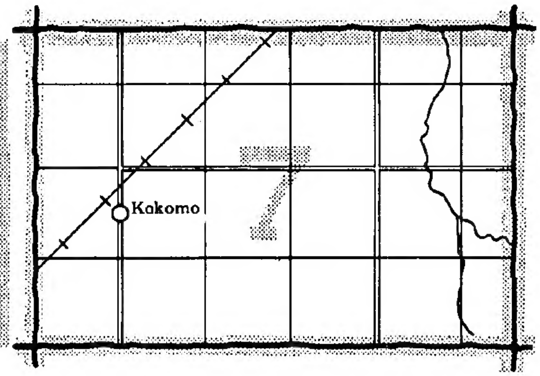
In cooperation with Kansas Agricultural Experiment Station

Soil Survey of Jewell County Kansas

HOW TO USE

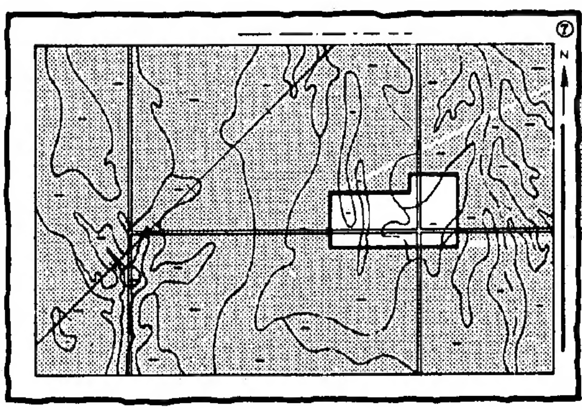
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

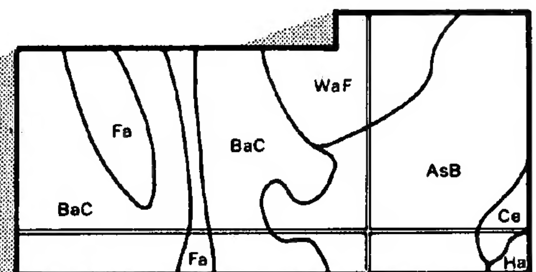




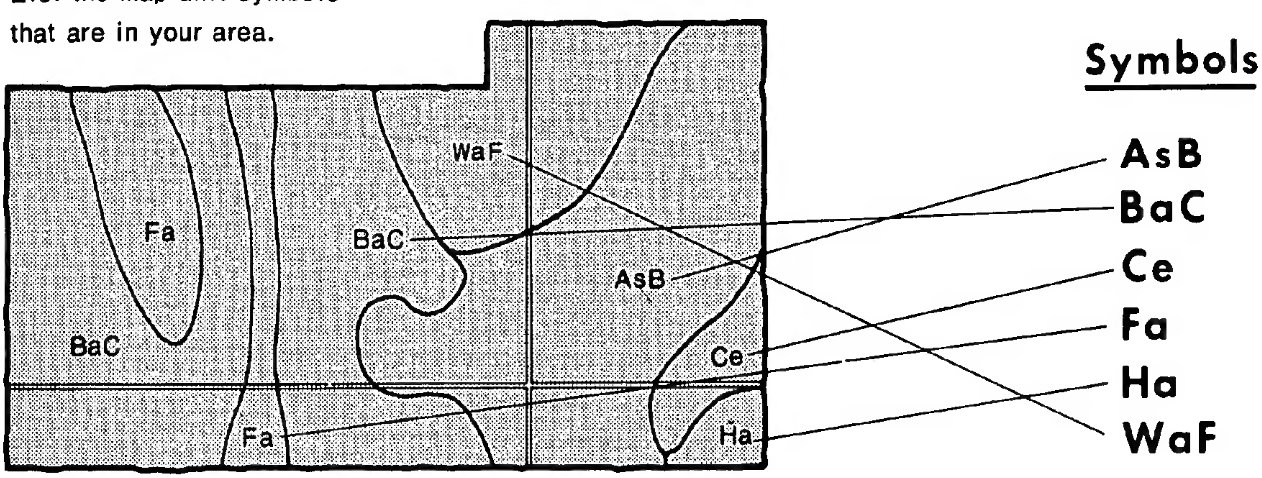
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



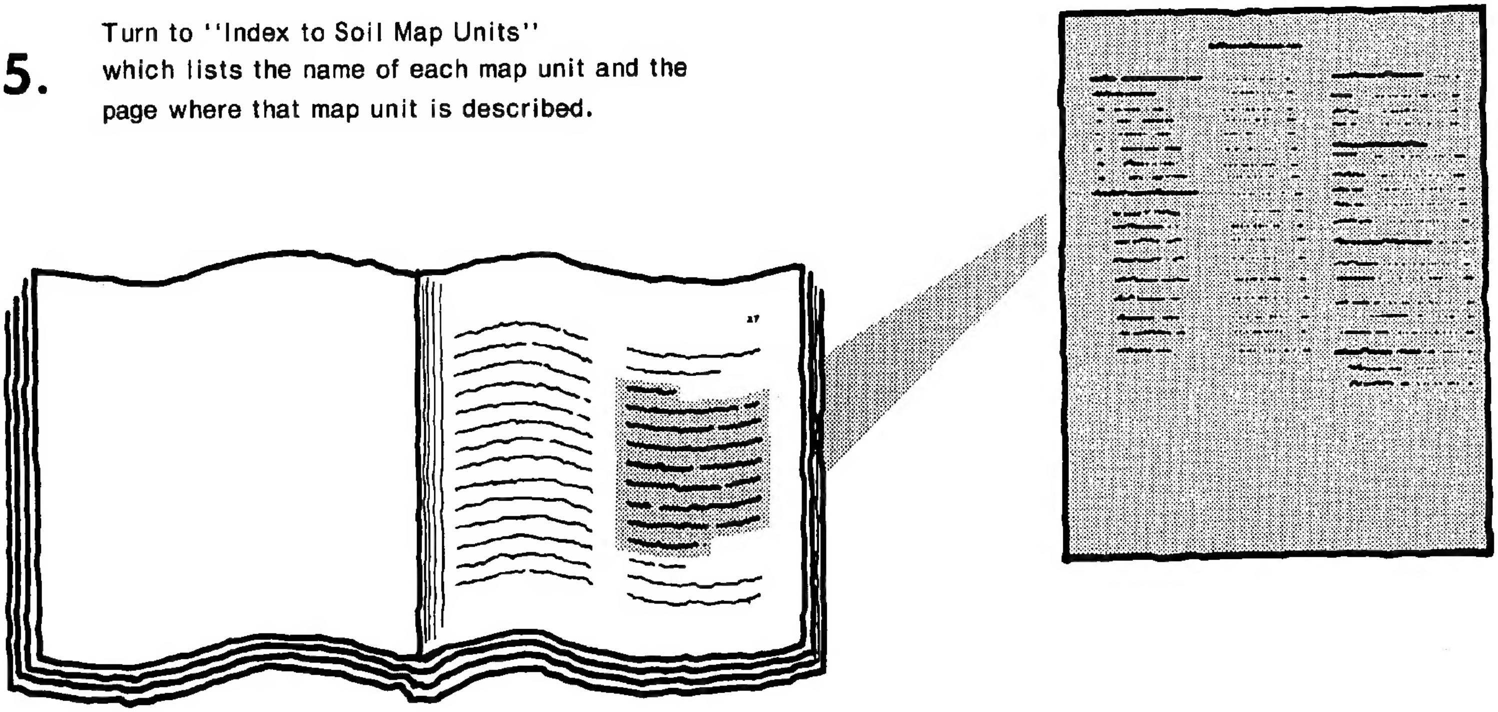


4. List the map unit symbols that are in your area.

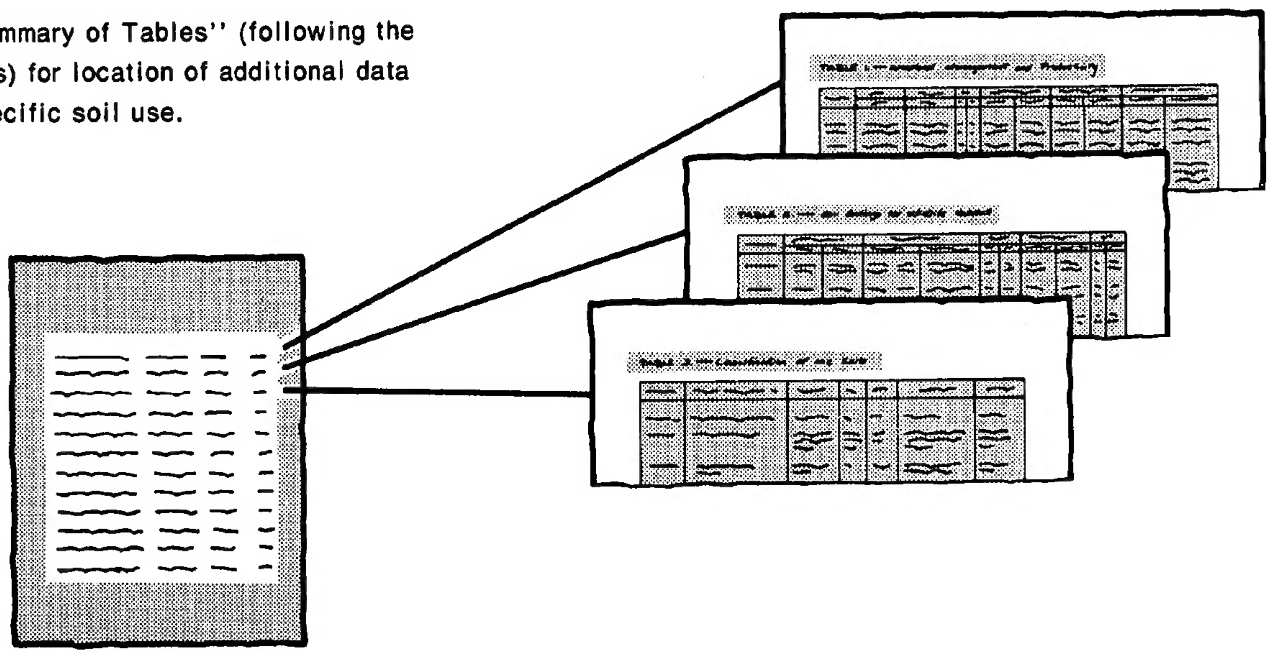


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; for specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

This survey was made cooperatively by the Soil Conservation Service and the Kansas Agricultural Experiment Station. It is part of the technical assistance furnished to the Jewell County Conservation District. Major fieldwork for this soil survey was performed in the period 1976-81. Soil names and descriptions were approved in 1981. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1981.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

This survey supersedes a soil survey of Jewell County published in 1914 (*4*).

Cover: An area of Harney silt loam, 1 to 3 percent slopes. Contour farming helps prevent excessive soil loss.

Contents

Soil Series

Issued May 1984

Index to Map Units

Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Jewell County, Kansas. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

John W. Tippie

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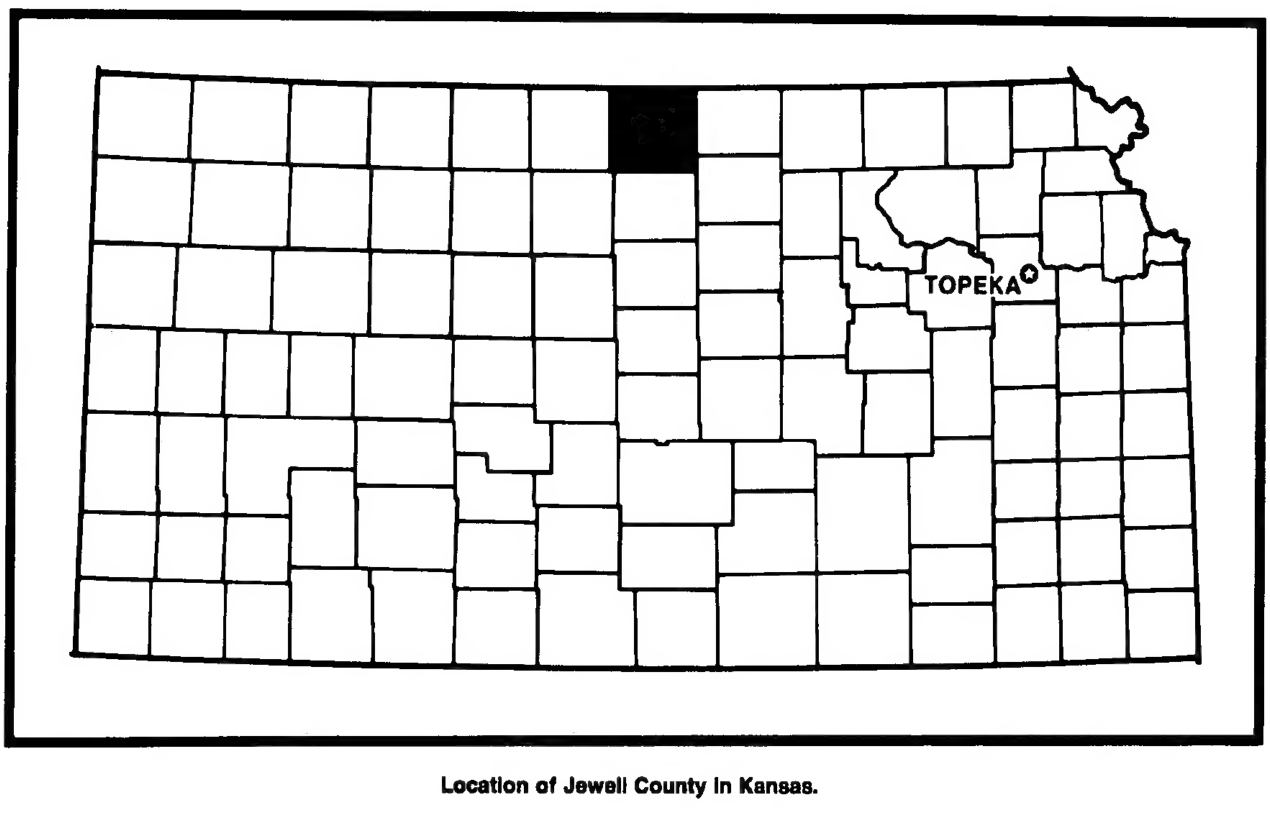
State Conservationist
Soil Conservation Service



Location of Jewell County in Kansas.

Soil Survey of Jewell County, Kansas

By Vernon L. Hamilton, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service
In cooperation with Kansas Agricultural Experiment Station

Jewell County is in north-central Kansas. It is bordered on the north by Nebraska. The total area of the county is 585,600 acres, or 915 square miles. In 1980, the population was 5,241. In that year, Mankato, the county seat, had a population of 1,226. The county was organized in 1870.

Jewell County is mostly in the Rolling Plains and Breaks Land Resource Area. A small area in the northeastern part of the county is in the Central Loess Plains Land Resource Area. Generally, the soils are deep and nearly level to strongly sloping. They have a silty subsoil. Elevation ranges from 1,960 feet in the northwestern part of the county to about 1,400 feet along Plum Creek in the southeastern part. Most of the county is drained by the Republican River, White Rock Creek, Buffalo Creek, and Limestone Creek.

Farming and ranching are the main enterprises. According to the 1967 Conservation Needs Inventory, about 65 percent of the county is used for cultivated crops. The principal crops are wheat and grain sorghum.

General Nature of the County

This section gives general information concerning the climate and natural resources of the county.

Climate

Prepared by L. Dean Bark, climatologist, Kansas Agricultural Experiment Station, Manhattan, Kansas.

The climate in Jewell County is typically continental, corresponding to its location in the interior of a large land mass in the middle latitudes. A continental climate is characterized by wide daily and annual variations in temperature. Winters are cold because of frequent outbreaks of air from the Polar regions. Cold temperatures, however, last only from December through February. The warm temperatures in summer last for about 6 months every year; the transitional seasons of spring and fall are relatively short. The predominance of warm temperatures provides a long growing season for crops in the county.

Jewell County is along the western edge of the flow of moisture-laden air from the Gulf of Mexico. The amount of precipitation received varies considerably according to shifts in the air current. Precipitation is heaviest from May through September, and much of it comes as thunderstorms late in the evening or at night. Precipitation in dry years is marginally sufficient for agricultural production, and even in wet years prolonged periods without rain are common and can produce stress in growing crops.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Belleville and Beloit in the period 1951 to 1976. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 29.4 degrees F, and the average daily minimum temperature is 18.7 degrees. The lowest temperature on record, which occurred at Belleville on February 13, 1905, is -31 degrees. In summer the average temperature is 76.8 degrees, and the average daily maximum temperature is 88.7 degrees. The highest recorded temperature, which occurred at Belleville on July 13, 1934, is 115 degrees.

The total annual precipitation is 25.37 inches. Of this, 19.07 inches, or 75 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 13.08 inches. The heaviest 1-day rainfall during the period of record was 5.81 inches at Lovewell Dam on September 18, 1978.

The average seasonal snowfall is 25.6 inches. The greatest snow depth at any one time during the period of record was 71.4 inches, which occurred during the winter of 1959-1960 at Mankato. On an average of 31 days, at least 1 inch of snow is on the ground. However, it is

unusual for the snow cover to last more than 2 weeks in succession.

The sun shines 76 percent of the time possible in summer and 66 percent in winter. The prevailing wind is from the south-southeast. Average windspeed is 12.2 miles per hour. It is highest in March.

Tornadoes and severe thunderstorms occur occasionally in Jewell County. These storms are usually local and of short duration. The risk of damage is slight. Hail falls infrequently and in small areas during the warmer part of the year. Crop damage by hail is less in this part of the state than in the western counties.

Natural Resources

The most valuable natural resource in Jewell County is its soils. More than 75 percent of the soils in the county are suited to cultivated crops. The steeper soils, which are not suited to crops, produce good quality native grasses.

The main sources of water in sufficient quantity and of suitable quality for irrigation are in the northeastern part of the county. Reservoirs supply most of the irrigation water, although in a few places wells are used. Domestic water is supplied by wells or through the rural water district.

Limestone is quarried in many areas and is used as road rock. Sources of sand and gravel are limited mainly to the Republican River Valley.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will

always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed, and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soils on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit, or association, on the general soil map is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in other associations but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The names, descriptions, and delineations of the soils identified on the general soil map for this county do not fully agree with those of the soils identified on the maps for adjacent counties. Differences result from a better knowledge of the soils, modifications in series concepts, a higher or lower intensity of mapping, and variations in the extent of the soils in the counties.

Soil Descriptions

1. Harney-Holdrege-Geary Association

Deep, nearly level to strongly sloping, well drained soils that have a silty subsoil; on uplands

This association consists of soils on ridgetops and side slopes that are dissected by many drainageways. The slope ranges from 0 to 11 percent.

This association makes up about 40 percent of the county. It is about 35 percent Harney soils, 30 percent Holdrege soils, 10 percent Geary soils, and 25 percent minor soils (fig. 1).

The Harney soils formed in loess. Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown silty clay loam about 8 inches thick. The subsoil is firm silty clay loam about 26 inches thick. In the upper part it is grayish brown, and in the lower part it is pale brown. The subsoil is calcareous below a depth of 30 inches. The substratum to a depth of 60 inches is very pale brown, calcareous silt loam.

The Holdrege soils formed in loess. Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is grayish brown silt loam about 6 inches thick. The subsoil is about 20 inches thick. The upper part is brown, friable silty clay loam; the middle part is very pale brown, firm silty clay loam; and the lower part is very pale brown, friable silt loam. The substratum to a depth of 60 inches is very pale brown, calcareous silt loam.

The Geary soils formed in reddish brown loess. Typically, the surface layer is dark grayish brown silt loam about 10 inches thick. The subsoil is silty clay loam about 30 inches thick. It is brown and friable in the upper part, brown and firm in the middle part, and light brown and friable in the lower part. The substratum to a depth of 60 inches is reddish brown, calcareous silty clay loam.

The minor soils in this association are Armo, Nuckolls, Roxbury, and Wakeen soils. Armo soils are loamy and calcareous. They are on foot slopes. Nuckolls soils are on steeper side slopes. They have slightly less clay in the subsoil than Geary soils. Roxbury soils are calcareous and are on narrow flood plains. Wakeen soils are moderately deep and are on lower side slopes.

The soils in this association are used mainly for cultivated crops. However, in about 30 percent of the areas they are used for pasture or range. If the soils are cultivated, controlling erosion, conserving moisture, and maintaining fertility are the main concerns in management. Maintaining good forage production is the main concern in managing range and pasture.

2. Roxbury-Hord-New Cambria Association

Deep, nearly level, well drained and moderately well drained soils that have a silty or clayey subsoil; on terraces and flood plains

This association consists of soils on terraces and flood plains along major streams. The slope ranges from 0 to 2 percent.

This association makes up about 9 percent of the county. It is about 40 percent Roxbury soils, 20 percent Hord soils, 5 percent New Cambria soils, and 35 percent minor soils.

The Roxbury soils are well drained. They formed in calcareous alluvium on stream terraces and flood plains. Typically, the surface layer is grayish brown, calcareous silt loam about 6 inches thick. The subsurface layer is

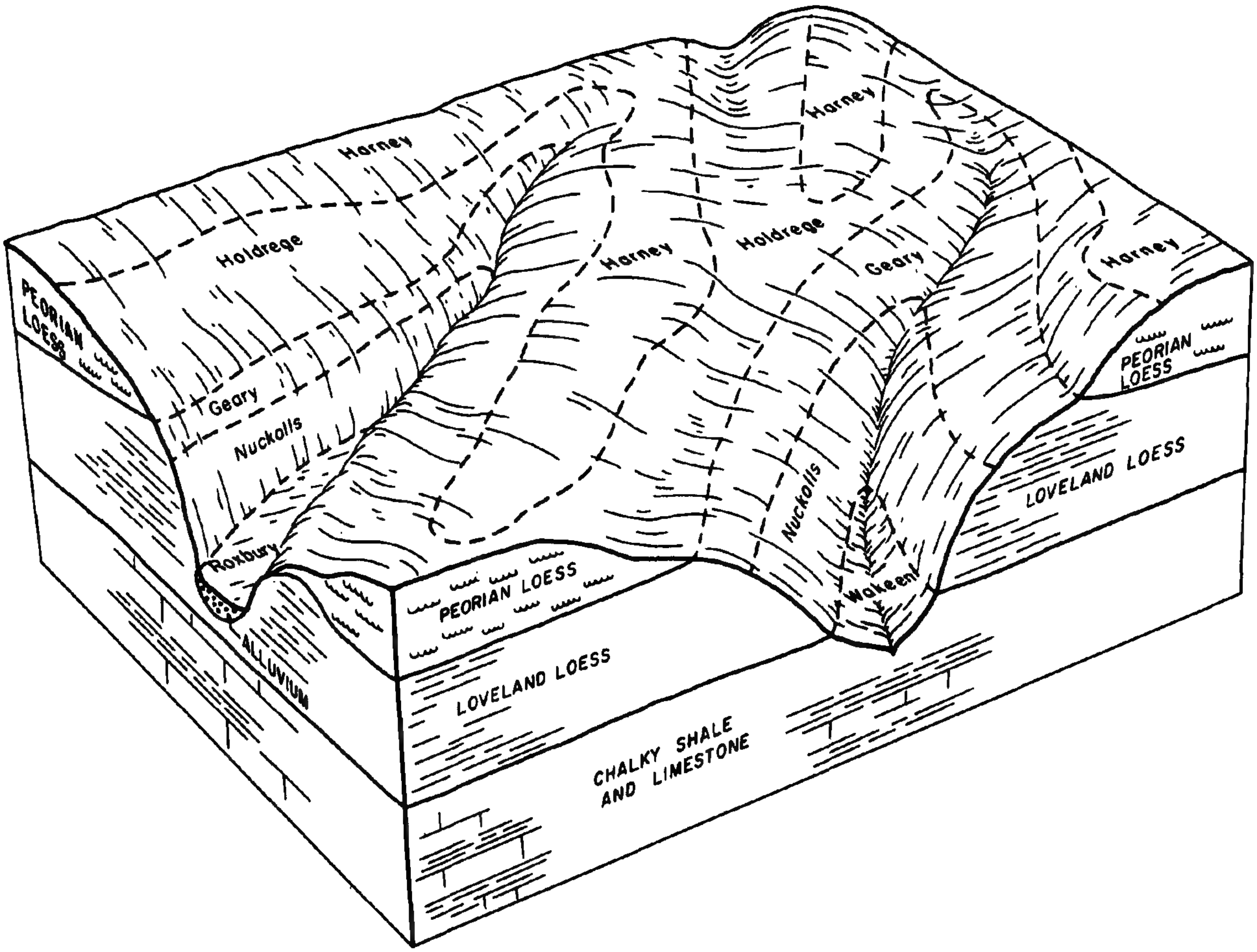


Figure 1.—Typical pattern of soils and underlying material in the Harney-Holdrege-Geary association.

dark grayish brown, very friable, calcareous silt loam about 18 inches thick. The subsoil is grayish brown, friable, calcareous silt loam about 12 inches thick. The substratum to a depth of 60 inches is light brownish gray, calcareous silty clay loam in the upper part and light gray, calcareous silt loam in the lower part.

The Hord soils are well drained. They formed in alluvium on terraces. Typically, the surface layer is grayish brown silt loam about 6 inches thick. The subsurface layer is grayish brown, friable silt loam about 10 inches thick. The subsoil is silt loam about 26 inches thick. The upper part is dark gray and very friable, and the lower part is light brownish gray and friable. The subsoil is calcareous below a depth of 30 inches. The substratum to a depth of 60 inches is dark grayish brown, calcareous silt loam.

The New Cambria soils are moderately well drained. They formed in calcareous alluvium on terraces. Typically, the surface layer is gray silty clay about 4 inches thick. The subsurface layer is dark gray, very firm silty clay about 11 inches thick. The subsoil is gray, very firm silty clay about 23 inches thick. The substratum to a depth of about 60 inches is grayish brown silty clay loam. The soil is calcareous throughout.

Some of the minor soils in this association are Armo, McCook, Detroit, Gibbon, and Inavale soils. Armo soils are calcareous and are on foot slopes. McCook soils are less clayey and are on terraces near stream channels. The Detroit soils are on terraces. They have a less clayey surface layer than New Cambria soils. Inavale

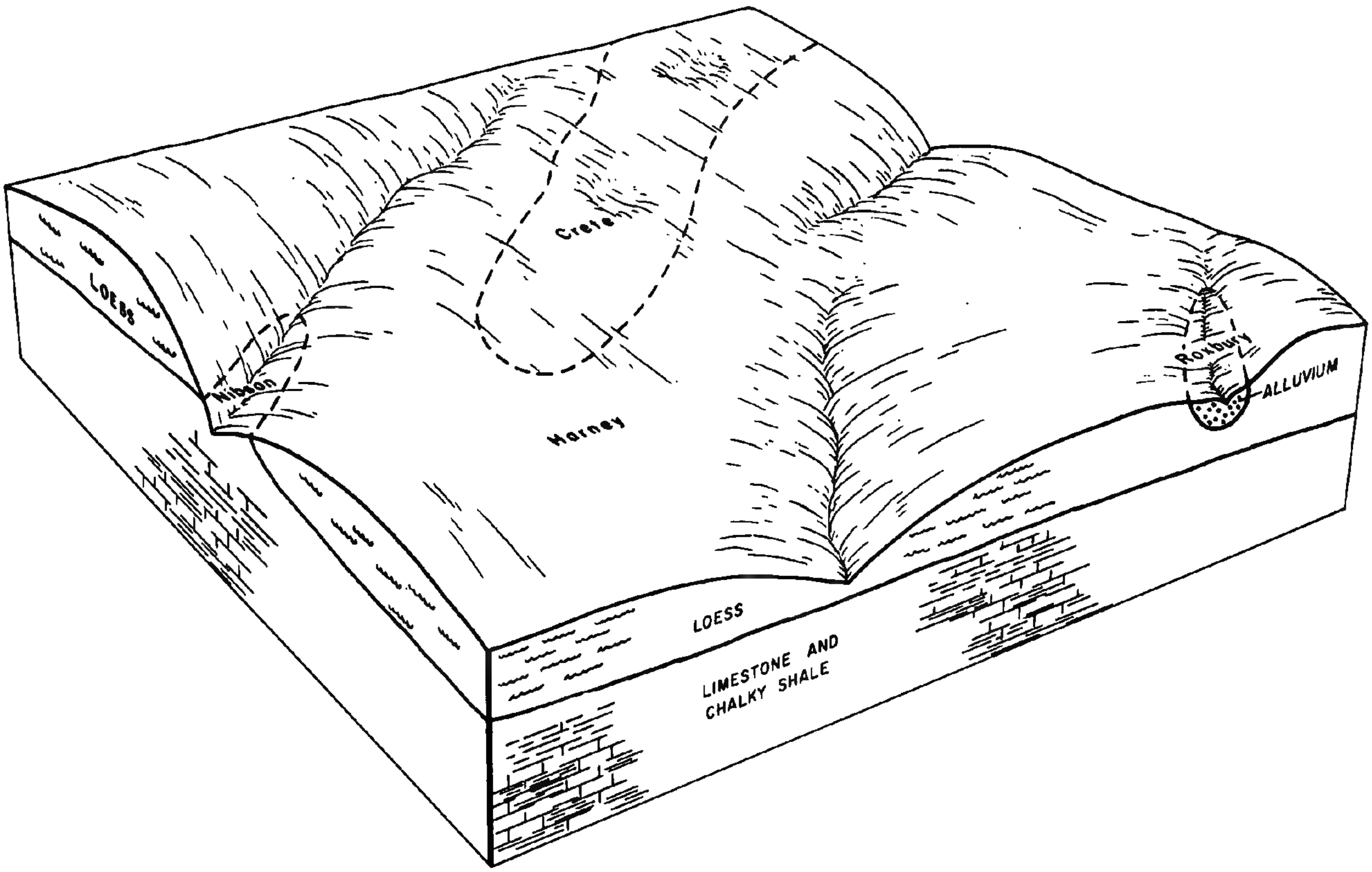


Figure 2.—Typical pattern of soils and underlying material in the Harney-Crete association.

soils are on flood plains and are somewhat excessively drained. Gibbon soils are on slightly concave flood plains and are somewhat poorly drained.

The soils in this association are used mainly for cultivated crops. In a few areas they are irrigated. Maintaining tilth and fertility is the main concern in management.

3. Harney-Crete Association

Deep, nearly level to moderately sloping, well drained and moderately well drained soils that have a silty or clayey subsoil; on uplands

This soil association consists of soils on broad ridgetops that are dissected by narrow drainageways. The slope ranges from 0 to 7 percent.

This association makes up about 20 percent of the county. It is about 84 percent Harney soils, 6 percent Crete soils, and 10 percent minor soils (fig. 2).

The Harney soils are well drained. They formed in loess. Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown, firm silty clay loam about 8 inches thick. The subsoil is firm silty clay loam about 26 inches thick. In the upper part it is grayish brown, and in the lower part it is pale brown. The subsoil is calcareous below a depth of 30 inches. The substratum to a depth of 60 inches is very pale brown, calcareous silt loam.

The Crete soils are moderately well drained. They formed in loess on broad, nearly level ridgetops. Typically, the surface layer is dark gray silt loam about 6 inches thick. The subsurface layer is dark gray, friable silty clay loam about 6 inches thick. The subsoil is about 28 inches thick. The upper part is dark gray, firm silty clay loam; the middle part is dark grayish brown and grayish brown, very firm silty clay; and the lower part is grayish brown, firm silty clay loam. The substratum to a depth of 60 inches is very pale brown, mottled silty clay loam that has few accumulations of lime.

The minor soils in this association are Nibson and Roxbury soils. The Nibson soils are shallow and are on steep side slopes along drainageways. The Roxbury soils are calcareous and are on flood plains.

The soils in this association are used mainly for cultivated crops. Wheat and grain sorghum are the main crops. In some areas in the northeastern part of the county, the soils are irrigated. Maintaining fertility, conserving moisture, and controlling erosion are the main concerns in management.

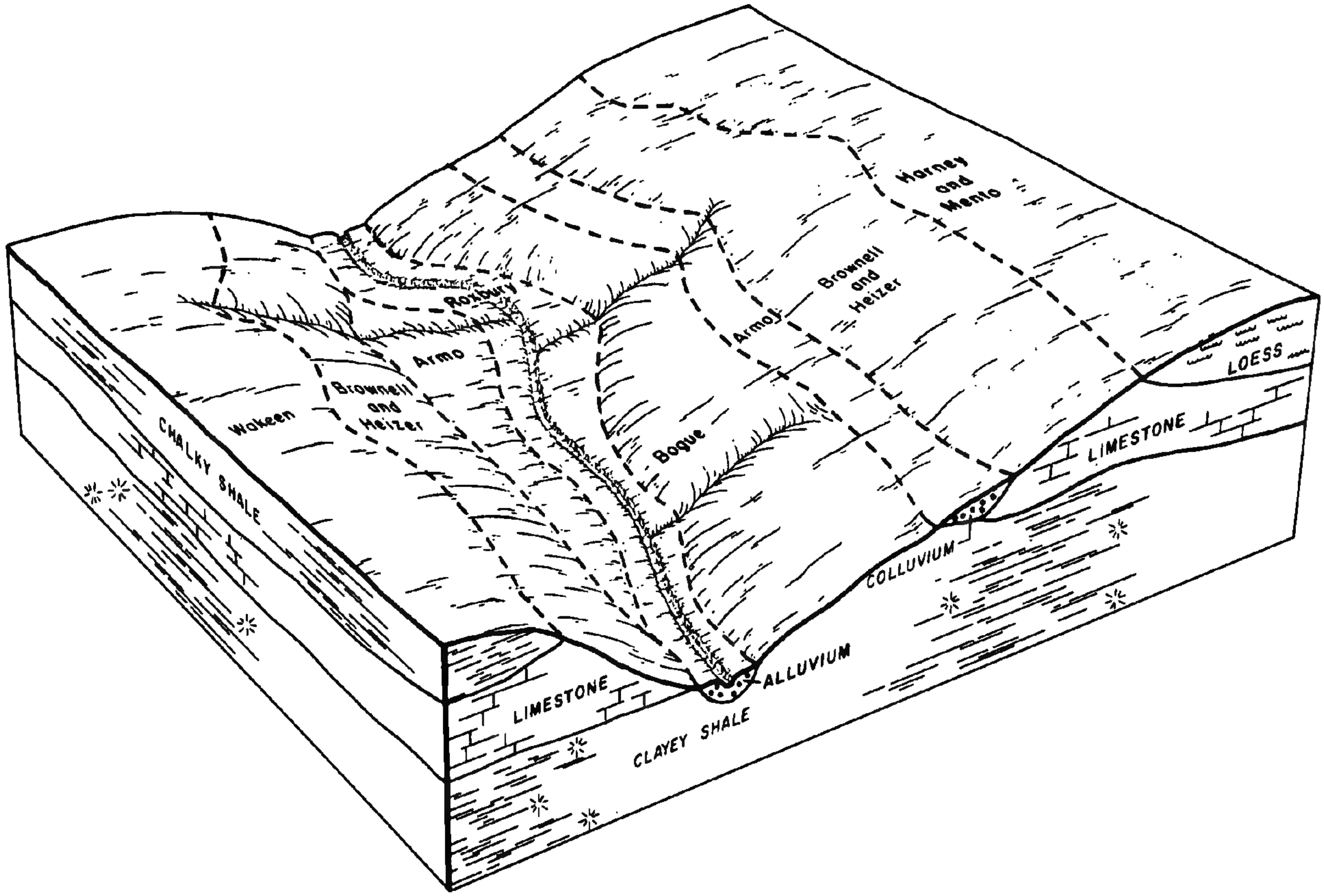


Figure 3.—Typical pattern of soils and underlying material in the Brownell-Wakeen-Bogue association.

4. Brownell-Wakeen-Bogue Association

Moderately deep, moderately sloping to moderately steep, well drained and moderately well drained soils that have a loamy, silty, or clayey subsoil; on uplands

This association consists of soils on narrow ridgetops and side slopes that are dissected by drainageways. The slope ranges from 3 to 20 percent.

This association makes up about 16 percent of the county. It is about 20 percent Brownell soils, 20 percent Wakeen soils, 15 percent Bogue soils, and 45 percent minor soils (fig. 3).

The Brownell soils are well drained. They formed in residuum of chalky limestone. Typically, the surface layer is grayish brown gravelly loam about 8 inches thick. The subsoil is grayish brown, friable very gravelly loam about 8 inches thick. The substratum is very pale brown, very channery loam. Chalky limestone is at a depth of about 32 inches. The soil is calcareous throughout.

The Wakeen soils are well drained. They formed in residuum of chalky shale. Typically, the surface layer is gray silt loam about 10 inches thick. The subsoil is silty clay loam about 24 inches thick. In the upper part it is light brownish gray, and in the lower part it is very pale brown. Chalky shale is at a depth of about 34 inches. The soil is calcareous throughout.

The Bogue soils are moderately well drained. They formed in residuum of clayey shale. Typically, the surface layer is gray clay about 8 inches thick. The layer below that is gray, mottled, extremely firm clay about 10 inches thick. The substratum is olive gray, mottled clay. Shale is at a depth of about 32 inches.

The minor soils in this association are Armo, Harney, Heizer, Mento, and Roxbury soils. Armo soils are deep and are on lower side slopes. Harney and Mento soils are deep and are on ridgetops. Heizer soils are shallow and are on steep side slopes. Roxbury soils are deep and are on flood plains along drainageways.

The soils in this association are used mainly as rangeland. In about 20 percent of the areas they are used for cultivated crops. If these soils are used as rangeland, the main concern in management is maintaining a vigorous stand of native grass. Controlling

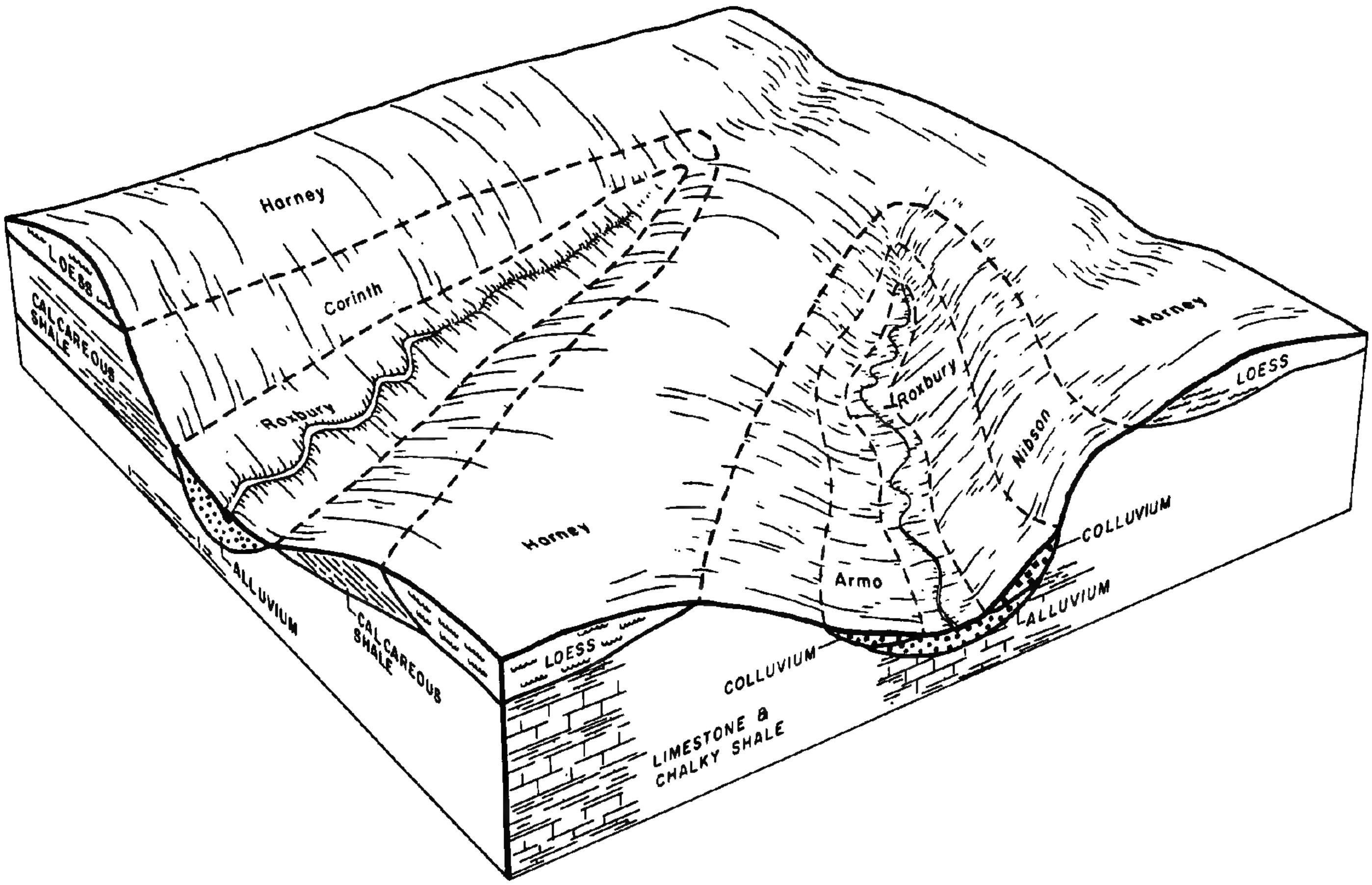


Figure 4.—Typical pattern of soils and underlying material in the Harney-Roxbury-Corinth association.

erosion and maintaining soil tilth and fertility are concerns in managing cropland.

5. Harney-Roxbury-Corinth Association

Deep and moderately deep, nearly level to moderately sloping, well drained soils that have a silty subsoil; on uplands and flood plains

This association consists of soils on convex ridgetops, side slopes, and flood plains that are dissected by intermittent streams. The slope ranges from 0 to 7 percent.

This association makes up about 15 percent of the county. It is about 60 percent Harney soils, 14 percent Roxbury soils, 7 percent Corinth soils, and 19 percent minor soils (fig. 4).

The Harney soils are deep. They formed in loess on ridgetops and upper side slopes. Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown, firm silty clay loam about 8 inches thick. The subsoil is firm silty clay loam about 26 inches thick. In the upper part it is grayish brown, and in the lower part it is pale brown. Accumulations of lime are below a depth of 30 inches. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The Roxbury soils are deep. They formed in calcareous alluvium on flood plains. Typically, the surface layer is grayish brown, calcareous silt loam about 6 inches thick. The subsurface layer is dark grayish brown, friable, calcareous silt loam about 18 inches thick. The subsoil is grayish brown, friable, calcareous silt loam about 12 inches thick. The substratum to a depth of 60 inches is light gray, calcareous silt loam.

The Corinth soils are moderately deep. They formed in residuum of calcareous shale. Typically, the surface layer is grayish brown, calcareous silty clay loam about 5 inches thick. The subsurface layer is grayish brown, firm, calcareous silty clay loam about 4 inches thick. The subsoil is yellowish brown, firm, calcareous silty clay loam about 11 inches thick. The substratum is yellow, calcareous silty clay loam. Shale is at a depth of about 32 inches.

Some of the minor soils in this association are Armo and Nibson soils. Armo soils are deep and calcareous. They are on lower side slopes. Nibson soils are shallow and are on steeper side slopes.

The soils in this association are used mainly for cultivated crops. About 20 percent of the acreage is used for range. Controlling erosion and maintaining soil tilth are the main concerns in managing these soils.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Harney silt loam, 1 to 3 percent slopes is one of several phases in the Harney series.

Some map units are made up of two or more major soils. These map units are called soil complexes or undifferentiated groups.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Bogue-Armo complex, 3 to 15 percent slopes is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in a mapped area are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Holdrege and Geary silty clay loams, 6 to 11 percent slopes, eroded is an undifferentiated group in this survey area.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, quarries is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

The names, descriptions, and delineations of the soils identified on the detailed soil maps for this county do not fully agree with those of the soils identified on the maps for adjacent counties. Differences result from a better knowledge of the soils, modifications in series concepts, a higher or lower intensity of mapping, and variations in the extent of the soils in the counties.

Soil Descriptions

Ao—Armo loam, 1 to 3 percent slopes. This is a deep, gently sloping, well drained soil on foot slopes. Individual areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is dark gray, calcareous loam about 6 inches thick. The subsurface layer, about 10 inches thick, is also dark gray, calcareous loam. The subsoil is light brownish gray, friable, calcareous loam about 14 inches thick. The substratum to a depth of about 60 inches is pale brown, calcareous gravelly clay loam. In a few small areas where the soil is eroded, the surface layer is clay loam.

Included with this soil in mapping and making up 5 to 10 percent of the unit are small areas of Roxbury soils.

The Roxbury soils have a thick, dark colored surface layer. They are on terraces and flood plains.

Permeability is moderate, and runoff is medium. The available water capacity is high. The content of organic matter is moderate. Natural fertility is high. The surface layer is mildly alkaline. Tilth is good.

In most areas this soil is used for cultivated crops. In a few areas it is in range. This soil is well suited to wheat, grain sorghum, forage sorghum, and alfalfa. If the soil is used for cultivated crops, erosion is a hazard. Minimum tillage, grassed waterways, terracing, and farming on the contour help reduce soil loss. Leaving crop residue on the soil helps maintain the content of organic matter, improves water infiltration, and helps maintain good tilth.

This soil is well suited as a site for dwellings and moderately well suited as a site for local roads and streets. Low soil strength is a problem if the soil is used for local roads and streets. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength.

This soil is well suited to use as septic tank absorption fields and moderately well suited to sewage lagoons. Seepage and slope can be a problem if the soil is used for sewage lagoons. Sealing the lagoon helps reduce seepage. If less sloping areas are selected as a site for the lagoon, less leveling and banking are required. In some places this soil is a source of limestone gravel for road surface material.

This soil is in capability subclass IIe.

Ar—Armo loam, 3 to 7 percent slopes. This is a deep, moderately sloping, well drained soil on foot slopes of limestone hills. Individual areas of the soil are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is dark grayish brown, calcareous loam about 6 inches thick. The subsurface layer is dark gray, friable, calcareous loam about 10 inches thick. The subsoil is light brownish gray, friable, calcareous loam about 14 inches thick. The substratum to a depth of about 60 inches is pale brown, calcareous gravelly clay loam. In a few small areas where the soil has eroded, the surface layer is clay loam. In a few areas the surface layer is silty clay loam and is noncalcareous.

Permeability is moderate, and runoff is medium. The available water capacity is high. The content of organic matter is moderate, and natural fertility is medium. The soil is mildly alkaline or moderately alkaline throughout. The surface layer has good tilth.

In about half of the areas this soil is used for cultivated crops. In the remaining areas it is used as rangeland (fig. 5). This soil is moderately well suited to wheat, alfalfa, and hay and pasture grasses. Grain sorghum is also grown. However, it is susceptible to chlorosis because of the high content of lime. If cultivated crops are grown, erosion is a hazard. Terraces, grassed waterways, contour farming, and minimum tillage help reduce erosion. Crop residue left on the surface reduces the runoff, helps control erosion, improves water infiltration, and helps maintain the content of organic matter and good tilth.

On rangeland, the dominant native vegetation is big bluestem, little bluestem, and sideoats grama. If the range is overgrazed, the less productive plants, for example, blue grama, tall dropseed, and western ragweed, increase. Proper stocking rates, timely deferment of grazing, and a rotation grazing system help keep the range in good condition. Range seeding is needed to restore productivity on abandoned cropland. Tame grass pastures benefit from timely grazing and from fertilization.

In many areas range is adjacent to cropland. The areas in between can be managed as habitat for upland wildlife, for example, pheasants. Shrubs planted in these fringe areas provide winter cover for wildlife.

This soil is well suited as a site for dwellings. It is moderately well suited as a site for local roads and streets. Low strength is a limitation for local roads and streets. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength.

The soil is well suited to use as septic tank absorption fields and moderately well suited as a site for sewage lagoons. Seepage can be a problem if the soil is used for sewage lagoons. Sealing the lagoon helps reduce seepage. If a less sloping area is selected as a site for the lagoon, less leveling and banking are required.

This soil is in capability subclass IIIe.

Ba—Bogue-Armo complex, 3 to 15 percent slopes. This map unit consists of moderately deep and deep, moderately sloping and strongly sloping soils on side slopes and knolls. The areas are dissected by entrenched drainageways. Soil sloughs or slips are common on the steeper Bogue soil (fig. 6). The map unit consists of about 60 percent Bogue soil, 25 percent Armo soil, and 15 percent included soils. Areas of the Bogue and Armo soils are so intricately mixed or so small in size that it was not practical to map them separately. Individual areas of this map unit are irregular in shape and range from 20 to several hundred acres in size.

The Bogue soil is moderately well drained. It is on knolls and strongly sloping side slopes. Typically, the surface layer is gray clay about 8 inches thick. The layer below that is gray, mottled, extremely firm clay about 10 inches thick. The substratum is olive gray, mottled clay. Shale is at a depth of about 32 inches.

The Armo soil is deep and well drained. It is less sloping than the Bogue soil and is on side slopes and along upland drainageways. Typically, the surface layer is dark grayish brown, calcareous loam about 10 inches thick. The subsoil is about 12 inches thick. It is light brownish gray, friable, calcareous clay loam. The

Figure 5.—In many areas Armo loam, 3 to 7 percent slopes, is used as rangeland.

substratum to a depth of about 60 inches is light brownish gray, calcareous gravelly clay loam.

Included with these soils in mapping and making up about 15 percent of the map unit are small areas of Corinth and New Cambria soils and shale outcrops. Corinth soils are moderately deep and are calcareous. They are on lower side slopes. New Cambria soils are deep and clayey. They are on terraces. Shale outcrops are on the steeper, higher side slopes.

Permeability is moderate in the Armo soil and very slow in the Bogue soil. Surface runoff is rapid on both soils. The available water capacity is high in the Armo soil and low in the Bogue soil. In the Armo soil the content of organic matter is moderate, and natural fertility is medium. In the Bogue soil the content of organic matter is moderately low, and natural fertility is low. Root development is restricted by the shale bedrock at a depth of about 34 inches in the Bogue soil. The shrink-swell potential is high in the Bogue soil.

In nearly all of the areas these soils are used for range. They are generally not suited to cultivated crops because of the severe hazard of erosion. The native vegetation is dominantly big bluestem, little bluestem, and sideoats grama. Leadplant is more common on the Bogue soil than on the Armo soil. Overgrazing reduces the protective plant cover and causes deterioration of the plant community. The more desirable vegetation is replaced by less productive grasses and weeds. Proper stocking rates, uniform distribution of grazing, and timely deferment of grazing help keep the range in good

Figure 6.—An area of Bogue-Armo complex, 3 to 15 percent slopes. Slippage is common on the steeper Bogue soil.

condition. In some of the larger areas these soils are suitable as sites for stockwater ponds.

The Bogue soil is generally not suited to building site development because of the high shrink-swell potential and depth to bedrock.

The Armo soil is moderately well suited as a site for dwellings, local roads and streets, septic tank absorption fields, and sewage lagoons. Because of slope, some land shaping commonly is needed on sites for buildings. Low strength is a limitation for local roads and streets. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength. Slope is a limitation for septic tank absorption fields and sewage lagoons. Seepage is an additional problem for lagoons. Sanitary facilities should be installed in the less sloping areas of the Armo soil. Seepage can be controlled by sealing the lagoon.

These soils are in capability subclass VIe.

Bb—Bogue-Rock outcrop complex, 10 to 30 percent slopes. This map unit consists of moderately deep, strongly sloping to steep, moderately well drained soils and outcrops of shale bedrock on uplands. The areas are dissected by deeply entrenched drainageways. Soil sloughs or slips are common. The complex consists of about 75 percent Bogue soil, 15 percent shale outcrops, and 10 percent included soils. The areas of Bogue soil and shale outcrops are so intricately mixed, or so small in size, that it was not practical to map them separately. Individual areas of the complex are irregular in shape and range from 20 to several hundred acres in size.

The Bogue soil is on ridgetops and side slopes. Typically, the surface layer is gray clay about 8 inches thick. The layer below that is about 10 inches thick. It is gray, mottled, extremely firm clay. The substratum is olive gray clay. Shale is at a depth of about 32 inches. In some places the surface layer is loam. In some places shale bedrock is at a depth of less than 20 inches.

Typically, the rock outcrops are barren, gray, clayey shale. They are on the steeper side slopes.

Included in mapping, and making up about 10 percent of the map unit, are small areas of deep gravelly loam soils on upper side slopes. These included soils have fragments of chalky shale and limestone.

Permeability of the Bogue soil is very slow, and runoff is rapid. The available water capacity is low. The content

of organic matter is moderately low, and natural fertility is low. The surface layer is neutral. Root development is restricted below a depth of about 34 inches. The subsoil has high shrink-swell potential.

Nearly all of the areas are used for range. The Bogue soil is not suited to cultivated crops because erosion is a severe hazard and the slopes are too steep. Native vegetation on the Bogue soil is dominantly big bluestem, little bluestem, and sideoats grama. Major concerns in management are controlling erosion and increasing the low available water capacity.

Overgrazing reduces the growth and vigor of the grasses and increases runoff. Rapid runoff causes severe erosion and increases the size of the areas of barren shale outcrops. Maintaining an adequate vegetative cover helps reduce runoff and prevent excessive soil loss. Proper stocking rates, uniform distribution of grazing, and timely deferment of grazing help keep the range in good condition.

The Bogue soil and the other areas that make up this map unit generally are not suited to building site development because of steep slopes and the moderate depth to bedrock.

This soil is in capability subclass VIIe.

Bh—Brownell-Heizer gravelly loams, 3 to 30 percent slopes. This map unit consists of moderately deep and shallow, moderately sloping to steep soils on side slopes and narrow ridgetops. The areas are dissected by deeply entrenched drainageways. The map unit consists of about 65 percent Brownell soil, 20 percent Heizer soil, and 15 percent included soils. Areas of the Brownell and Heizer soils are so intricately mixed, or so small in size, that it was not practical to map them separately. Individual areas of this unit are irregular in shape and range from 20 to several hundred acres in size.

The Brownell soil is well drained and less sloping than the Heizer soil. It is on upper side slopes. Typically, the surface layer is grayish brown gravelly loam about 8 inches thick. The subsoil is grayish brown, friable very gravelly loam about 8 inches thick. The substratum is very pale brown very channery loam (fig. 7). Chalky limestone is at a depth of about 32 inches. The soil is calcareous throughout.

The Heizer soil is shallow and somewhat excessively drained. It is on narrow ridgetops and sharp slope breaks. Typically, the surface layer is dark gray gravelly loam about 6 inches thick. The layer below that is gray, friable channery loam about 4 inches thick. The substratum is light brownish gray very channery loam. Chalky limestone is at a depth of about 15 inches.

Included with these soils in mapping and making up about 15 percent of the map unit are small areas of Armo and Mento soils and limestone rock outcrops. The Armo soils are deep and are on lower side slopes. The Mento soils are deep and are on upper side slopes and

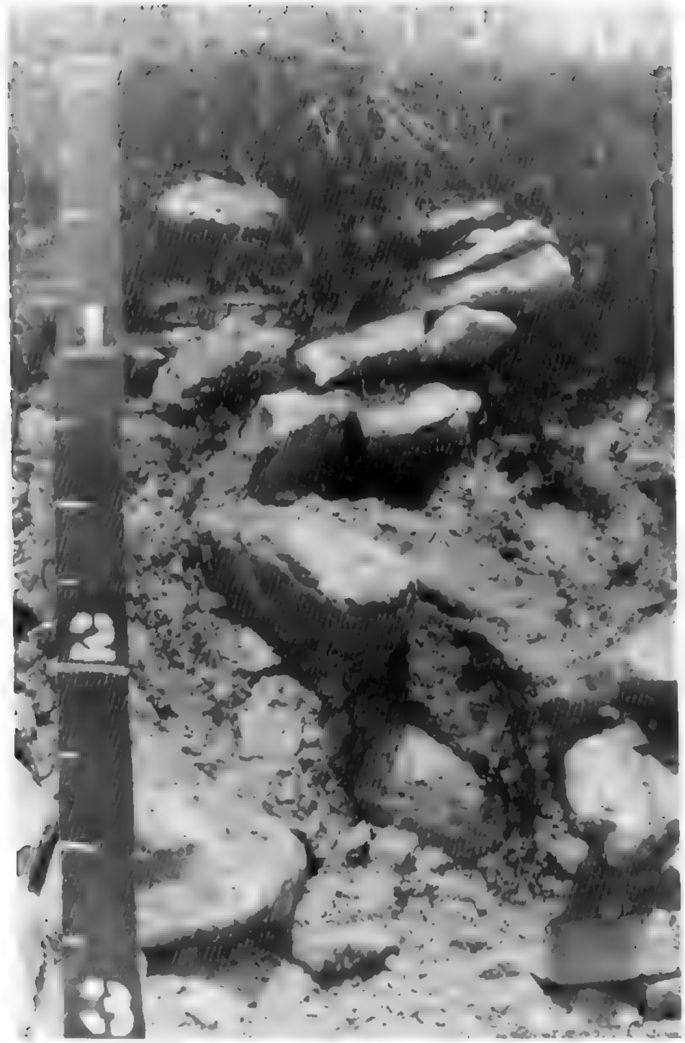


Figure 7.—The subsoil and substratum of the Brownell soil have many limestone fragments. Depth is shown in feet.

ridgetops. Limestone rock outcrops are on steep slopes near areas of the Heizer soils.

Permeability and the content of organic matter are moderate in both soils. The available water capacity is low in the Brownell soil and very low in the Heizer soil. Runoff is rapid. Root development is restricted at a depth of about 32 inches in the Brownell soil and about 15 inches in the Heizer soil.

In nearly all of the areas these soils are used for range. They are not suited to cultivated crops because of rockiness and steep slopes. Native vegetation is dominantly big bluestem, little bluestem, and sideoats grama. Little bluestem is more common on the shallow Heizer soil. Overgrazing reduces the protective plant cover and causes deterioration of the plant community. An adequate plant cover reduces runoff and conserves

moisture. Proper stocking rates, a uniform distribution of grazing, and timely deferment of grazing help to keep the range in good condition. Proper placement of salt and water facilities helps improve grazing distribution.

These soils are generally not suited to building site development because of depth to bedrock and slope.

These soils are in capability subclass VIIs.

Ca—Carr fine sandy loam. This is a deep, nearly level, well drained soil on low terraces. It is occasionally flooded. Individual areas of this soil are irregular in shape and range from 10 to 30 acres in size.

Typically, the surface layer is grayish brown, calcareous fine sandy loam about 8 inches thick. The substratum to a depth of about 42 inches is light brownish gray, very friable, calcareous fine sandy loam. To a depth of about 60 inches it is light gray, calcareous fine sand.

Included with this soil in mapping and making up about 10 percent of the map unit are small areas of Inavale soils. The Inavale soils are sandy and are on mounds.

Permeability is moderately rapid, and runoff is slow. The available water capacity is moderate. The content of organic matter is low, and natural fertility is medium. The soil is mildly alkaline or moderately alkaline throughout. The surface layer is very friable, and tilth is good.

In most areas this soil is cultivated. It is moderately well suited to corn, wheat, grain sorghum, forage sorghum, and alfalfa. The main concerns in management are controlling soil blowing, conserving soil moisture, and maintaining fertility. Minimum tillage, stripcropping, and use of cover crops help reduce soil blowing. Crop residue returned to the soil helps conserve moisture and maintain the content of organic matter and fertility. Proper use of fertilizers helps maintain or improve fertility.

This soil generally is not suited to building site development because of the hazard of flooding. This limitation is difficult to overcome; major flood control measures are required.

This soil is in capability subclass IIs.

Ch—Corinth-Harney silty clay loams, 3 to 7 percent slopes, eroded. This map unit consists of moderately deep and deep, moderately sloping, well drained soils on side slopes and narrow ridgetops. The areas are along drainageways. The map unit consists of about 60 percent Corinth soil, 30 percent Harney soil, and 10 percent included soils. Areas of the Corinth and Harney soils are so intricately mixed or so small in size that it was not practical to map them separately. Individual areas of this unit are irregular in shape and range from 20 to 100 acres in size.

The Corinth soil is generally more sloping than the Harney soil. It is on side slopes. Typically, the surface layer is grayish brown, calcareous silty clay loam about 5 inches thick. The subsurface layer is grayish brown, firm, calcareous silty clay loam about 4 inches thick. The subsoil is yellowish brown, firm, calcareous silty clay loam about 11 inches thick. The substratum is yellow, calcareous silty clay loam. Shale is at a depth of about 32 inches.

The Harney soil is deep. It is on narrow ridgetops and upper side slopes. Typically, the surface layer is dark grayish brown silty clay loam about 7 inches thick. The subsoil is about 26 inches thick. The upper part is grayish brown, firm silty clay loam; the middle part is pale brown, firm silty clay loam; and the lower part is pale brown, firm, calcareous silty clay loam. The substratum is very pale brown, calcareous silt loam to a depth of 60 inches.

Included with these soils in mapping and making up about 10 percent of the map unit are small areas of Armo and Roxbury soils. The Armo soils are deep and calcareous and are on lower side slopes. The Roxbury soils are deep and are on flood plains in upland drainageways.

Permeability is moderately slow in both the Corinth and Harney soils. Runoff is rapid in both soils. The available water capacity is moderate in the Corinth soil and high in the Harney soil. The content of organic matter and natural fertility are low in the Corinth soil. The content of organic matter is moderately low and natural fertility is medium in the Harney soil. The surface layer of the Harney soil is neutral. The Corinth soil is mildly alkaline or moderately alkaline throughout. Root development is restricted below a depth of about 32 inches in the Corinth soil. Tilth is fair in both soils.

In most areas these soils are used for cultivated crops. In the remaining areas they are used for range. The soils are poorly suited to cultivated crops. Wheat and grain sorghum are the main crops. If cultivated crops are grown, further erosion is a hazard. Terraces, contour farming, and minimum tillage help control runoff and erosion. Crop residue left on the surface and barnyard manure added to the soil increase the infiltration rate and improve tilth.

These soils are suited to use as rangeland. A grass cover effectively controls erosion. Abandoned cropland needs to be reseeded to native grass. Proper stocking rates and a rotation grazing system help keep the range in good condition. Fertilizer increases forage production of tame grasses.

These soils are moderately well suited as a site for dwellings and local roads and streets. However, the shrink-swell potential is a problem for these uses. The shrinking and swelling of the soil can damage houses and other buildings. Such damage can be prevented or minimized if the building is properly designed and the foundation is reinforced. Installing drains around the foundation and backfilling with porous material also help. Adding coarser grained base material helps reduce damage to roads and streets caused by shrinking and swelling. Low strength is an additional limitation for local

roads and streets. Roads and streets need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength.

The Corinth soil generally is not suitable for septic tank absorption fields or sewage lagoons because of depth to bedrock. The Harney soil is better for these uses. The absorption of effluent from septic tank systems is somewhat restricted by the moderately slow permeability in the Harney soil. The effluent is more readily absorbed by the soil if lateral lines are placed below the clayey subsoil. Enlarging the absorption field also helps. Seepage from lagoons can be a problem in the Harney soil. Sealing the lagoon helps reduce seepage. Some land shaping is commonly required in constructing a sewage lagoon.

These soils are in capability subclass IVe.

Cr—Crete silt loam, 0 to 1 percent slopes. This is a deep, nearly level, moderately well drained soil on broad, flat or slightly depressional uplands. Individual areas of this soil range from 80 to several hundred acres in size.

Typically, the surface layer is dark gray silt loam about 6 inches thick. The subsurface layer is dark gray, friable silty clay loam about 6 inches thick. The subsoil is about 28 inches thick. It is dark gray, firm silty clay loam in the upper part; dark grayish brown and grayish brown, very firm silty clay in the middle part; and grayish brown, firm silty clay loam in the lower part. The substratum to a depth of about 60 inches is very pale brown, mottled silty clay loam.

Permeability and runoff are slow. The available water capacity is high. The content of organic matter is moderate, and natural fertility is high. The surface layer is medium acid. Tilth is good. The shrink-swell potential of the subsoil is high.

In nearly all of the areas this soil is used for cultivated crops. It is suited to dryland or irrigated crops. Wheat and grain sorghum are the main crops in the dryland areas. The clayey subsoil restricts the movement of water into the soil and releases moisture slowly to growing plants. Minimum tillage and crop residue left on the surface help prevent compaction, improve fertility and tilth, and increase the infiltration rate.

In the irrigated areas, corn and grain sorghum are the principal crops. The main concerns in management are using irrigation water efficiently and maintaining the content of organic matter and soil fertility. Crop residue left on the surface effectively maintains the content of organic matter and fertility. Land leveling and water management help to improve water distribution.

This soil is moderately well suited to local roads and streets and to dwellings. Low strength and the shrinking and swelling of the soil are limitations for roads and streets. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength. Adding coarser grained base material helps prevent damage caused by the shrinking and swelling. The shrinking and swelling of the soil can damage houses and other buildings. Such damage can be prevented or minimized if the building is properly designed and the foundation is reinforced. Installing drains around the foundation and backfilling with porous material also help.

This soil is poorly suited to use as a site for septic tank absorption fields because of the slow permeability. The effluent is more readily absorbed by the soil if lateral lines are placed below the clayey subsoil. Enlarging the absorption field also helps. This soil is moderately well suited to sewage lagoons, although seepage can be a problem. Sealing the lagoon helps reduce seepage. In places the clayey subsoil can be used to seal the floor of the lagoon.

This soil is in capability subclass IIs.

De—Detroit silty clay loam. This is a deep, nearly level, moderately well drained soil on terraces. It is rarely flooded. Individual areas are irregular in shape and range from 15 to 400 acres in size.

Typically, the surface layer is dark gray silty clay loam about 6 inches thick. The subsurface layer is dark gray, friable silty clay loam about 6 inches thick. The subsoil is about 30 inches thick. In the upper part it is dark grayish brown, very firm silty clay; and in the lower part it is grayish brown, mottled, firm, calcareous silty clay loam. The substratum to a depth of about 60 inches is light brownish gray, mottled, calcareous silty clay loam. In some places the depth to lime is less than 22 inches.

Included with this soil in mapping and making up about 15 percent of the map unit are small areas of well drained Hord soils and more clayey New Cambria soils. The Hord soils are in slightly higher positions on the landscape than this Detroit soil. The New Cambria soils are in slightly lower positions.

Permeability and runoff are slow. The available water capacity is high. The content of organic matter is moderate, and natural fertility is high. The surface layer is slightly acid. Tilth is good. The subsoil has high shrink-swell potential.

In nearly all of the areas this soil is used for cultivated crops. It is suited to dryland or irrigated crops. Wheat and grain sorghum are the main crops in dryland areas. The clayey subsoil restricts the movement of water into the soil and releases moisture slowly to growing plants. Minimum tillage and crop residue left on the surface help prevent compaction, improve fertility and tilth, and increase the infiltration rate.

In irrigated areas, corn and grain sorghum are the principal crops. The main concerns in management are using irrigation water efficiently and maintaining the content of organic matter and soil fertility. Crop residue returned to the soil is effective in maintaining the content of organic matter and fertility. Land leveling and water management help improve water distribution.

This soil is poorly suited as a site for dwellings because of flooding and the shrink-swell potential. Protecting the soil with dikes, levees, and other structures reduces the hazard of flooding. Onsite inspection is needed to select suitable building sites on the higher parts of the landscape. Shrinking and swelling of the soil can damage houses and other buildings. Such damage can be prevented or minimized if the building is properly designed and the foundation is reinforced. Installing drains around the foundation and backfilling with porous material also help.

This soil is moderately well suited to local roads and streets. Low strength and the shrink-swell potential are limitations. Roads and streets need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength. Adding coarser grained base material reduces damage caused by the shrinking and swelling of the soil.

This soil is well suited to use as a site for sewage lagoons. It is poorly suited to use as septic tank absorption fields. The slow permeability limits the absorption of effluent. Increasing the size of the absorption field helps overcome this limitation.

This soil is in capability class I.

Ge—Geary silt loam, 3 to 7 percent slopes. This is a deep, moderately sloping, well drained soil on upland slopes and valley side slopes. Individual areas of this soil are irregular in shape and range from 10 to 80 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 10 inches thick. The subsoil is about 30 inches thick. It is brown, friable silty clay loam in the upper part; brown, firm silty clay loam in the middle part; and light brown, friable silty clay loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, calcareous silty clay loam. In some places the subsoil is grayish brown.

Included with this soil in mapping and making up about 10 percent of the map unit are small areas of Roxbury and Wakeen soils. The Roxbury soils are calcareous and are on flood plains. The Wakeen soils are moderately deep and are on lower side slopes.

Permeability is moderate, and runoff is medium. The available water capacity is high. The content of organic matter is moderate, and natural fertility is high. The surface layer is medium acid. Tilth is good. The subsoil has moderate shrink-swell potential.

In about two-thirds of the areas this soil is used for cultivated crops. In the remaining areas it is used as rangeland. This soil is moderately well suited to wheat, grain sorghum, forage sorghum, and hay and pasture grasses. If the soil is used for cultivated crops, erosion is a hazard. Terraces, grassed waterways, contour farming, and minimum tillage help reduce excessive soil loss. Crop residue left on the surface reduces the runoff rate, improves water infiltration, and helps maintain the content of organic matter and good tilth.

On rangeland, the native vegetation is dominantly big bluestem, little bluestem, and switchgrass. If the range has been overused, blue grama, buffalograss, and sideoats grama dominate. Proper stocking rates, timely deferment of grazing, and uniform grazing distribution help keep the range in good condition. Range seeding is needed to restore productivity on abandoned cropland.

In many areas range is adjacent to cropland. The areas in between can be managed as habitat for upland wildlife, for example, pheasant. Shrubs planted in these fringe areas provide winter cover for wildlife.

This soil is moderately well suited as a site for dwellings and for local roads and streets. The shrinking and swelling of the soil can damage houses and other buildings. Such damage can be prevented or minimized if the building is properly designed and the foundation is reinforced. Installing drains around the foundation and backfilling with porous material also help. Low strength is a problem if the soil is used for roads and streets. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength.

This soil is moderately well suited to sewage disposal systems. The absorption of effluent in septic tank systems is somewhat restricted by the moderate permeability. Enlarging the absorption field helps overcome this limitation. Seepage from lagoons can be a problem. Sealing the floor of the lagoon helps reduce seepage. If a less sloping area is selected for the lagoon, less leveling and banking are required.

This soil is in capability subclass IIIe.

Gf—Geary silty clay loam, 3 to 7 percent slopes, eroded. This is a deep, moderately sloping, well drained soil on side slopes and ridgetops. Individual areas are irregular in shape and range from 10 to 80 acres in size.

Typically, the surface layer is grayish brown silty clay loam about 6 inches thick. The subsoil is brown, firm silty clay loam about 24 inches thick. The substratum to a depth of about 60 inches is reddish brown silty clay loam. In some places the surface layer is thicker and less clayey.

Included with this soil in mapping and making up about 10 percent of the unit are small areas of Roxbury and Wakeen soils. The Wakeen soils are moderately deep and are on lower side slopes. The Roxbury soils are deep and are on flood plains in upland drainageways.

Permeability is moderate, and runoff is medium. The available water capacity is high. The content of organic matter is moderately low, and natural fertility is medium. The surface layer is slightly acid. Tilth is good. The shrink-swell potential of the soil is moderate.

In about three-fourths of the areas this soil is used for cultivated crops. In the remaining areas it is used as rangeland. It is moderately well suited to grain sorghum,

wheat, and alfalfa. If the soil is used for cultivated crops, erosion is a hazard. Terraces, grassed waterways, contour farming, and minimum tillage help reduce excessive soil loss. Crop residue left on the surface reduces the runoff rate, improves water infiltration, and helps maintain the content of organic matter and good tilth.

This soil is suited to use as range or pasture for haying or grazing. The major concerns in managing range or pasture are controlling erosion and increasing low forage production on abandoned cropland. An adequate plant cover reduces the runoff rate, helps prevent excessive soil loss, and increases the moisture supply. Proper stocking rates and timely deferment of grazing help keep the range in good condition. Tame grass pastures benefit from timely grazing and fertilization. Range seeding is needed to restore productivity on abandoned cropland.

This soil is moderately well suited as a site for dwellings and for local roads and streets. The shrink-swell potential can be a problem. The shrinking and swelling of the soil can damage houses and other buildings. Such damage can be prevented or minimized if the building is properly designed and the foundation is reinforced. Installing drains around the foundation and backfilling with porous material also help. Low strength is a limitation for roads and streets. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength.

This soil is moderately well suited to sewage disposal systems. The absorption of effluent in septic tank systems is somewhat restricted by the moderate permeability. Enlarging the absorption field helps overcome this limitation. Seepage from lagoons can be a problem. Sealing the floor of the lagoon helps reduce seepage. If a less sloping area is selected as a site for the lagoon, less leveling and banking are required.

This soil is in capability subclass IIIe.

Gn—Gibbon silty clay loam. This is a deep, nearly level, somewhat poorly drained soil on low flood plains. It is occasionally flooded for brief periods. Individual areas are irregular in shape and range from 10 to 40 acres in size.

Typically, the surface layer is grayish brown, calcareous silty clay loam about 5 inches thick. The subsurface layer is gray, friable, calcareous silty clay loam about 7 inches thick. The layer below that is grayish brown, mottled, friable, calcareous silty clay loam about 7 inches thick. The substratum to a depth of about 60 inches is light brownish gray, mottled, and calcareous. In the upper part it is silt loam, in the middle part it is very fine sandy loam, and in the lower part it is loamy sand.

Included with this soil in mapping and making up about 10 percent of the map unit are small areas of Carr and McCook soils. These soils are well drained and are more loamy than the Gibbon soil. They are in slightly higher positions on the landscape.

Permeability is moderately slow, and runoff is slow. The available water capacity is high. The content of organic matter is moderate, and natural fertility is high. The surface layer is mildly alkaline. Tilth is good. The subsoil has moderate shrink-swell potential. A seasonal high water table is at a depth of 1.5 to 3 feet in spring.

In about half of the areas this soil is used for cultivated crops. In the remaining areas it is used as rangeland. This soil is well suited to corn, soybeans, grain sorghum, and alfalfa. Tillage operations are sometimes delayed because of wetness. Wetness can be reduced by open drains or tile drains if adequate outlets are available. Minimum tillage and crop residue left on the surface help maintain the content of organic matter, fertility, and tilth.

On rangeland, the native vegetation is dominantly big bluestem, indiangrass, switchgrass, and prairie cordgrass. Willow trees are common in some places. If the range is overgrazed, the less productive grass and weeds, Kentucky bluegrass, Baldwin ironweed, and ragweed, for example, invade. Distribution of livestock can be improved by proper placement of fences and of water and salt facilities.

This soil is well suited as a site for excavated ponds. Ponds provide a dependable source of water for livestock or wildlife.

This soil is generally not suited to building site development because of flooding. This limitation is difficult to overcome; major control measures are required.

This soil is in capability subclass IIw.

Ha—Harney silt loam, 0 to 1 percent slopes. This is a deep, nearly level, well drained soil on broad upland ridgetops. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown, friable silty clay loam about 10 inches thick. The subsoil is firm silty clay loam about 26 inches thick. The upper part is grayish brown; the lower part is pale brown and has accumulations of lime. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

Permeability is moderately slow, and runoff is slow. The available water capacity is high. The content of organic matter is moderate, and natural fertility is high. The surface layer is slightly acid. Tilth is good. The subsoil has a moderate shrink-swell potential.

Nearly all areas of this soil are used for cultivated crops. The soil is suited to dryland or irrigated crops. Wheat and grain sorghum are the main crops in dryland areas. Minimum tillage and crop residue left on the

surface help prevent compaction, improve fertility and tilth, and increase the infiltration rate.

In irrigated areas, corn and grain sorghum are the principal crops. The main concerns in management are efficient use of irrigation and maintaining soil fertility. Crop residue returned to the soil effectively maintains the content of organic matter and fertility. Land leveling and water management help to improve water distribution.

This soil is moderately well suited as a site for dwellings and local roads and streets. The shrinking and swelling of the soil can damage houses and other buildings. Such damage can be prevented or minimized if the building is properly designed and the foundation is reinforced. Installing drains around the foundation and backfilling with porous material also help. Low strength is a limitation for roads and streets. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength.

The soil is moderately well suited as a site for septic tank absorption fields and sewage lagoons. The absorption of effluent in septic tank systems is somewhat restricted by the moderately slow permeability. The effluent is more readily absorbed by the soil if lateral lines are placed below the clayey subsoil. Enlarging the absorption field also helps. Seepage from lagoons can be a problem. In places, the clayey subsoil can be used to seal the lagoon and help reduce seepage.

This soil is in capability subclass IIc.

Hb—Harney silt loam, 1 to 3 percent slopes. This is a deep, gently sloping, well drained soil on broad upland ridgetops and side slopes. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown, friable silty clay loam about 8 inches thick. The subsoil is firm silty clay loam about 26 inches thick. In the upper part it is grayish brown, and in the lower part it is pale brown. The subsoil is calcareous below a depth of 30 inches. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some areas tillage has mixed the surface layer with the upper part of the subsoil, and the present surface layer is silty clay loam.

Included with this soil in mapping and making up about 5 percent of the map unit are small areas of Roxbury soils. Roxbury soils have a less clayey subsoil and are calcareous at or near the surface. They are on flood plains along upland drainageways.

Permeability is moderately slow, and runoff is slow. The available water capacity is high. The content of organic matter is moderate, and natural fertility is high. The surface layer is slightly acid. Tilth is good. The subsoil has moderate shrink-swell potential.

In most areas this soil is used for cultivated crops. In a few areas it is irrigated. The soil is well suited to wheat and grain sorghum in dryland areas. Erosion is a concern in management. Minimum tillage and crop residue returned to the soil surface help conserve moisture. Terraces and contour farming reduce runoff and excessive soil loss.

In irrigated areas, corn and grain sorghum are the principal crops. If gravity irrigation is used, some land leveling generally is needed to manage the irrigation water efficiently. Controlling the rate of application helps to conserve irrigation water.

This soil is moderately well suited as a site for dwellings and for local roads and streets. Shrinking and swelling of the soil can damage houses and other buildings. Such damage can be prevented or minimized if the building is properly designed and the foundation is reinforced. Installing drains around the foundation and backfilling with porous material also help. Low strength is a limitation for roads and streets. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength.

This soil is moderately well suited to use as septic tank absorption fields and as a site for sewage lagoons. The absorption of effluent in septic tank systems is somewhat restricted by the moderately slow permeability. The effluent is more readily absorbed by the soil if lateral lines are placed below the clayey subsoil. Enlarging the absorption field also helps. Seepage from lagoons can be a problem. In places, the clayey subsoil can be used to seal the lagoon and help reduce seepage. Some land shaping is commonly needed in order to construct a lagoon.

This soil is in capability subclass IIe.

Hc—Harney silt loam, 3 to 7 percent slopes. This is a deep, moderately sloping, well drained soil on side slopes on uplands. Individual areas are irregular in shape and range from 10 to 120 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown, friable silty clay loam about 6 inches thick. The subsoil is about 24 inches thick. It is grayish brown, firm silty clay loam in the upper part and pale brown, friable, calcareous silty clay loam in the lower part. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some places the depth to lime is less than 18 inches. In some places the upper part of the subsoil has been mixed with the surface layer by tillage, and the surface layer is silty clay loam.

Included in mapping and making up less than 10 percent of the map unit are small areas of Corinth and Wakeen soils. These soils are moderately deep and are on lower side slopes.

Permeability is moderately slow, and runoff is medium. The available water capacity is high. The content of organic matter is moderate, and natural fertility is high. The surface layer is neutral. Tilth is good. The subsoil has a moderate shrink-swell potential.

In about half the areas this soil is used for cultivated crops. In the rest of the areas it is used as rangeland. It is moderately well suited to grain sorghum, wheat, and alfalfa. If the soil is used for cultivated crops, erosion is a hazard. Terraces, grassed waterways, contour farming, and minimum tillage help reduce excessive soil loss. Crop residue left on the surface reduces runoff, improves water infiltration, and helps maintain the content of organic matter and the good tilth (fig. 8).

On rangeland, the native vegetation is dominantly big bluestem and little bluestem. Overgrazed areas are dominated by less productive grasses, for example, sideoats grama, blue grama, and buffalograss. Proper stocking rates and timely deferment of grazing help retain the most desirable grasses. Proper placement of salt and water facilities improves grazing distribution.

In many areas, range is adjacent to cropland. The areas in between can be managed as habitat for upland wildlife, for example, pheasants. Shrubs in these fringe areas provide winter cover for wildlife.

This soil is moderately well suited as a site for dwellings and local roads and streets. The shrinking and swelling of the soil can damage houses and other buildings. Such damage can be prevented or minimized if the building is properly designed and the foundation is reinforced. Installing drains around the foundation and backfilling with porous material also help. Low soil strength is a limitation for roads and streets. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength.

The soil is moderately well suited as a site for sewage disposal systems. The absorption of effluent in septic tank systems is somewhat restricted by the moderately slow permeability. The effluent is more readily absorbed by the soil if lateral lines are placed below the clayey subsoil. Enlarging the absorption field also helps. Seepage from lagoons can be a problem. In some places the more clayey subsoil material can be used to seal the floor of the lagoon to reduce seepage. If the less sloping areas are selected as a site for lagoons, less leveling and banking are required.

This soil is in capability subclass IIIe.

Hf—Harney silty clay loam, 3 to 7 percent slopes, eroded. This is a deep, moderately sloping, well drained soil on side slopes. Individual areas are irregular in shape and range from 10 to 40 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 6 inches thick. The subsoil is about 24 inches thick. It is grayish brown, firm silty clay loam in the upper part and pale brown, friable, calcareous silty clay loam in the lower part. The substratum to a depth of about 60 inches is pale brown, calcareous silt loam. In some places the depth to lime is less than 18 inches. In other places the subsoil and substratum are reddish brown. Tillage has mixed the surface layer and the upper part of the subsoil.

Included with this soil in mapping and making up about 15 percent of the map unit are small areas of Corinth and Wakeen soils and some areas of silty soils that are slightly affected by sodium. The Corinth and Wakeen soils are moderately deep and are on lower side slopes. The sodic soils are in concave areas.

Permeability is moderately slow, and runoff is medium. The available water capacity is high. The content of organic matter is moderately low, and natural fertility is medium. The surface layer is neutral. Tilth is fair. The subsoil has a moderate shrink-swell potential.

Most areas of this soil are used for cultivated crops. A few areas have been reseeded to native grasses. This soil is moderately well suited to grain sorghum, wheat, and alfalfa. If it is used for cultivated crops, further erosion is a hazard. Terraces, grassed waterways, contour farming, and minimum tillage help reduce excessive soil loss. Crop residue left on the surface reduces the runoff rate, improves water infiltration and tilth, and helps maintain the content of organic matter.

This soil is well suited to range. A grass cover effectively controls erosion. Range seeding is needed to restore productivity on abandoned cropland. Proper stocking rates and timely deferment of grazing help to keep the range in good condition.

This soil is moderately well suited as a site for dwellings and local roads and streets. The shrinking and swelling of the soil can damage houses and other buildings. Such damage can be prevented or minimized if the building is properly designed and the foundation is reinforced. Installing drains around the foundation and backfilling with porous material also help. Low soil strength is a limitation for roads and streets. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength.

The soil is moderately well suited as a site for sewage disposal systems. The absorption of effluent in septic tank systems is somewhat restricted by the moderately slow permeability. The effluent is more readily absorbed by the soil if lateral lines are placed below the clayey subsoil. Enlarging the absorption field also helps. Seepage from lagoons can be a problem. In some places the more clayey part of the subsoil can be used to seal the floor of the lagoon to reduce seepage. If the less sloping areas are selected as a site for lagoons, less leveling and banking are required.

This soil is in capability subclass IVe.

Hm—Harney-Mento silt loams, 3 to 7 percent slopes. This map unit consists of deep, moderately

Figure 8.—Crop residue left on the surface helps reduce runoff. The soil is Harney silt loam, 3 to 7 percent slopes.

sloping, well drained soils on side slopes and ridgetops. It is about 65 percent Harney soil, 20 percent Mento soil, and 15 percent included soils. Areas of the Harney and Mento soils are so intricately mixed, or so small in size, that it was not practical to map them separately. Individual areas of this map unit are irregular in shape and range from 10 to 160 acres in size.

The Harney soil is on upper side slopes and ridgetops. Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown, firm silty clay loam about 8 inches thick. The subsoil is grayish brown, firm silty clay loam about 26 inches thick. It is calcareous below a depth of 25 inches. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In places tillage has mixed the surface layer with the upper part of the subsoil, and the present surface layer is silty clay loam.

The Mento soil is on lower side slopes and in concave areas. Typically, the surface layer is grayish brown silt loam about 8 inches thick. The subsoil is about 34 inches thick. The upper part is dark grayish brown, very firm silty clay; the middle part is brown, very firm, calcareous silty clay; and the lower part is light yellowish brown, firm, calcareous silty clay loam. The substratum is very pale brown, calcareous clay loam. Chalky limestone is at a depth of about 46 inches.

Included with these soils in mapping are small areas of Brownell, Nibson, and Wakeen soils. These soils are on side slopes. Brownell and Wakeen soils are moderately deep, and Nibson soils are shallow.

Permeability is moderately slow in the Harney soil and slow in the Mento soil. Runoff is medium in both soils. The available water capacity is high in the Harney soil and moderate in the Mento soil. The content of organic matter is moderate in both soils. Natural fertility is high in the Harney soil and medium in the Mento soil. The

surface layer of both soils is neutral or mildly alkaline. Tilth is good in the Harney soil and poor in the Mento soil. The subsoil of the Harney soil has moderate shrink-swell potential, and that of the Mento soil has high shrink-swell potential (fig. 9).

About half of the area of these soils is used for cultivated crops. The remaining area is in range. These soils are poorly suited to cultivated crops. Grain sorghum, forage sorghum, and wheat are the main crops. If cultivated crops are grown, erosion is a hazard. Terraces, grassed waterways, contour farming, crop residue left on the soil, and minimum tillage help reduce erosion, maintain the content of organic matter, and improve tilth.

The native vegetation in areas of the Harney soil that are used for range is dominantly big bluestem and little bluestem, and in areas of the Mento soil it is grama and western wheatgrass. If the range is overgrazed, vegetative cover is reduced, the plant community deteriorates, and the tall grasses are replaced by less productive grasses and weeds. Proper stocking rates, uniform grazing distribution, timely deferment of grazing, and rotation grazing help keep the range in good condition. Range seeding is needed to restore productivity on abandoned cropland.

The Harney and Mento soils are moderately well suited to local roads and streets, dwellings, septic tank absorption fields, and sewage lagoons. The Mento soil is better suited to dwellings without basements than to dwellings with basements because of the depth to bedrock. If the Harney and Mento soils are used for local roads and streets, low strength is a limitation. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength. The shrink-swell potential is a limitation for buildings. The shrinking and swelling of the soil can damage houses and other buildings. Such damage can be prevented or minimized if the building is properly designed and the foundation is reinforced. Installing drains around the foundation and backfilling with porous material also help.

The moderately slow permeability of the Harney soil and the slow permeability of the Mento soil limit the absorption of effluent in septic tank systems. Increasing the size of the absorption field helps to overcome this limitation. The filter field performs better if lateral lines are placed below the clayey subsoil. Seepage and slope are limitations for sewage lagoons. The depth to bedrock in the Mento soil also is a limitation. Sealing the lagoon reduces seepage. Some land shaping is commonly needed in constructing a lagoon. The depth to bedrock in the Mento soil can be overcome by borrowing soil or ripping the bedrock. Sealant for the bottom of the lagoon may be needed to prevent excessive seepage into fractures in the bedrock.

These soils are in capability subclass IVe.

Ho—Holdrege silt loam, 3 to 7 percent slopes. This is a deep, moderately sloping, well drained soil on narrow divides and side slopes on uplands. Individual areas of this soil are irregular in shape and range from 20 to 200 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is grayish brown, friable silt loam about 6 inches thick. The subsoil is about 20 inches thick. The upper part is brown, friable silty clay loam; the middle part is very pale brown, firm silty clay loam; and the lower part is very pale brown, friable silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some places the subsoil is reddish brown. In some places the upper part of the subsoil has been mixed with the surface layer by tillage, and the surface layer is silty clay loam.

Included with this soil in mapping and making up about 5 percent of the map unit are small areas of Roxbury and Wakeen soils. Roxbury soils are on flood plains along drainageways. Wakeen soils are moderately deep and are on lower side slopes.

Permeability is moderate, and runoff is medium. The available water capacity is high. The content of organic matter is moderate, and natural fertility is high. The surface layer is slightly acid or medium acid and is friable. Tilth is good. The subsoil has a moderate shrink-swell potential.

About three-fourths of the area of this soil is used for cultivated crops. The remaining area is used as rangeland. The soil is moderately well suited to wheat, grain sorghum, forage sorghum, and hay and pasture grasses. If it is used for cultivated crops, erosion is a hazard. Terraces, grassed waterways, contour farming, and minimum tillage help reduce excessive soil loss. Crop residue left on the surface reduces the runoff rate, improves water infiltration, and helps maintain the content of organic matter and good tilth.

In a few areas this soil is irrigated with sprinkler systems. Corn and grain sorghum are the principal irrigated crops. The irrigation water increases the hazard of erosion. Water needs to be carefully controlled so that the application rate does not exceed the intake rate of the soil. Minimum tillage and crop residue left on the surface help reduce the runoff rate and prevent excessive soil loss.

In range, the native vegetation is dominantly big bluestem, little bluestem, indiangrass, and switchgrass. In areas that are continually overgrazed, these productive grasses are replaced by less desirable plants, for example, blue grama, buffalograss, and western ragweed. Proper stocking rates, timely deferment of grazing, and uniform distribution of grazing help keep the range in good condition.

In many areas, range is adjacent to cropland. The areas in between can be managed as habitat for upland

Figure 9.—The subsoil of the Mento soil has high shrink-swell potential. The soil cracks when it is dry.

wildlife, for example, pheasants. Shrubs in these fringe areas provide winter cover for wildlife.

This soil is moderately well suited as a site for dwellings and local roads and streets. The shrinking and swelling of the soil can damage houses and other buildings. Such damage can be prevented or minimized if the building is properly designed and the foundation is reinforced. Installing drains around the foundation and backfilling with porous material also help. Low strength is a problem if the soil is used for roads and streets. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength.

This soil is well suited as a site for septic tank absorption fields. Seepage from lagoons can be a problem. Sealing the floor of the lagoon helps reduce seepage. Less leveling and banking are required in the less sloping areas.

This soil is in capability subclass IIIe.

Hr—Holdrege silty clay loam, 3 to 7 percent slopes, eroded. This is a deep, moderately sloping, well drained soil on side slopes and ridgetops on uplands. Individual areas of this soil are irregular in shape and range from 10 to 80 acres in size.

Typically, the surface layer is grayish brown silty clay loam about 6 inches thick. The subsoil is grayish brown, firm silty clay loam about 16 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some places the surface layer is lighter colored because tillage has mixed it with subsoil material. In a few places the subsoil is reddish brown.

Included with this soil in mapping and making up about 5 percent of the map unit are small areas of Roxbury and Wakeen soils. The Roxbury soils are calcareous and are on flood plains in upland drainageways. The Wakeen soils are moderately deep and are on lower side slopes.

Permeability is moderate, and runoff is medium. The available water capacity is high. The content of organic matter is moderately low, and natural fertility is medium. The surface layer is slightly acid or neutral. Tilth is fair. The subsoil has moderate shrink-swell potential.

About three-fourths of the area of this soil is used for cultivated crops. The remaining area is used as rangeland. The soil is moderately well suited to wheat,

grain sorghum, forage sorghum, and hay and pasture grasses. If the soil is used for cultivated crops, erosion is a hazard. Terraces, grassed waterways, contour farming, and minimum tillage help reduce excessive soil loss. Crop residue left on the surface reduces the runoff rate, improves water infiltration, helps maintain the content of organic matter, and improves tilth.

This soil is suited to use as range. The major concern in managing range is increasing low production on abandoned cropland. An adequate plant cover reduces the runoff rate, helps prevent excessive soil loss, and increases moisture supply. Proper stocking rates and timely deferment of grazing help keep the range in good condition. Range seeding is needed to restore productivity on abandoned cropland.

The soil is moderately well suited as a site for dwellings and for local roads and streets. The shrink-swell potential can be a problem. The shrinking and swelling of the soil can damage houses and other buildings. Such damage can be prevented or minimized if the building is properly designed and the foundation is reinforced. Installing drains around the foundation and backfilling with porous material also help. Low strength is a problem if the soil is used for roads and streets. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength.

This soil is well suited to use as septic tank absorption fields. Seepage from lagoons can be a problem. Sealing the floor of the lagoon helps reduce seepage. If a less sloping area is selected as a site for the lagoon, less leveling and banking are required.

This soil is in capability subclass IIIe.

Hs—Holdrege and Geary silty clay loams, 6 to 11 percent slopes, eroded. These are deep, strongly sloping, well drained soils on side slopes along upland drainageways. An individual area of this map unit is made up of one or both of the major soils. The areas are long and narrow and range from 20 to 200 acres in size.

The map unit is about 50 percent Holdrege soil, 40 percent Geary soil, and 10 percent included soils. The Holdrege soil is mainly on upper side slopes in the western part of the county and is on some ridgetops in the eastern part. The Geary soil is on lower side slopes in the western part of the county, but it is mainly on upper side slopes in the eastern part. The pattern and proportion of these soils are not uniform in any of the mapped areas.

Typically, the surface layer of the Holdrege soil is grayish brown silty clay loam about 6 inches thick. The subsoil is grayish brown, firm silty clay loam about 16 inches thick. The substratum to a depth of 60 inches is very pale brown, calcareous silt loam.

Typically, the surface layer of the Geary soil is dark grayish brown silty clay loam about 6 inches thick. The subsoil is firm silty clay loam about 28 inches thick. It is brown in the upper part and light brown in the lower part. The substratum to a depth of about 60 inches is reddish brown silty clay loam.

Included in mapping are small areas of Roxbury and Wakeen soils. The Roxbury soils are calcareous and are on flood plains of upland drainageways. The Wakeen soils are moderately deep and are on lower side slopes.

Permeability is moderate in both the Holdrege and Geary soils. Runoff is rapid. The available water capacity is high. Natural fertility is medium. Reaction is slightly acid in the surface layer. The shrink-swell potential is moderate. Tilth is fair.

In most areas these soils are used for cultivated crops. In some areas they have been seeded to native grass. These soils are poorly suited to cultivated crops. Sorghum, winter wheat, and alfalfa are the main crops. If these soils are used for cultivated crops, further erosion is a hazard. Minimum tillage, terraces, and grassed waterways help prevent excessive soil loss. Crop residue left on the surface reduces runoff and improves water infiltration.

The soils are best suited to tame grass pasture and rangeland. A cover of grass effectively controls erosion. Proper stocking rates and timely deferment of grazing help keep the pasture and range in good condition. Range seeding is needed to restore productivity on abandoned cropland. Fertilizing tame grass pastures increases forage production.

These soils are moderately well suited as a site for dwellings and local roads and streets. The shrink-swell potential and slope are limitations for dwellings. Damage caused by the shrinking and swelling of the soil can be prevented or minimized if the building is properly designed and the foundation is reinforced. Installing drains around the foundation and backfilling with porous material also help. Land shaping is commonly needed to compensate for the slope. Low strength is a limitation for local roads and streets. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength.

The soils are moderately well suited to use as septic tank absorption fields and poorly suited to sewage lagoons. Slope is a limitation on both soils to use as septic tank absorption fields. Lateral lines should be constructed on the contour. The moderate permeability of the Geary soil limits the absorption of effluent from septic tank systems. Increasing the size of the absorption field helps overcome this limitation. Slope is a severe limitation for sewage lagoons. Land shaping is needed. If the less sloping areas are selected as sites for lagoons, less leveling and banking are required.

These soils are in capability subclass IVe.

Hu—Hord silt loam. This is a deep, nearly level, well drained soil on stream terraces. It is rarely flooded. Individual areas are irregular in shape and range from 10 to 120 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is grayish brown, friable silt loam about 10 inches thick. The subsoil is grayish brown silt loam about 26 inches thick. In the upper part it is friable, and in the lower part it is very friable and calcareous. The substratum to a depth of about 60 inches is dark grayish brown, calcareous silt loam. In some places the surface layer is calcareous.

Included with this soil in mapping and making up about 10 percent of the map unit are small areas of Detroit soils. The Detroit soils are moderately well drained and have a more clayey subsoil than the Hord soil. They are in slightly convex areas.

Permeability is moderate, and runoff is slow. The available water capacity is high. The content of organic matter is moderate. Natural fertility is high. The surface layer is neutral or slightly acid. Tilth is good.

This soil is used mainly for cultivated crops. It is well suited to dryland and irrigated crops. Wheat, grain sorghum, and alfalfa are the main crops in dryland areas. Conserving moisture is the main concern in management. Minimum tillage and crop residue left on the surface help conserve moisture and maintain fertility.

In irrigated areas, corn and grain sorghum are the principal crops. The main management concerns are efficiently using irrigation water and maintaining fertility. Crop residue returned to the soil effectively maintains the content of organic matter and fertility. Land leveling and water management help improve water distribution.

This soil is poorly suited as a site for dwellings because of the hazard of flooding. Protecting the soil from flooding by dikes, levees, and other structures reduces this hazard. Onsite inspection and knowledge of an area's flooding history are necessary in selecting suitable building sites. The soil is moderately well suited as a site for local roads and streets. Low strength is a limitation. Roads and streets need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength. Coarser grained base material can be used to insure better performance.

This soil is moderately well suited to use as septic tank absorption fields and for sewage lagoons. The hazard of flooding can be a problem for septic tank systems. Levees help reduce this hazard. Seepage is a limitation for sewage lagoons. Sealing the lagoon helps reduce seepage.

This soil is in capability class I.

Ie—Inavale fine sand. This is a deep, nearly level, somewhat excessively drained soil on flood plains of the Republican River. It is frequently flooded. In many places short escarpments border areas of this soil. Individual areas are long in shape and range from 40 to 160 acres in size.

Typically, the surface layer is light brownish gray, calcareous fine sand about 9 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous fine sand.

Included in mapping and making up about 10 percent of the map unit are small areas of Carr and McCook soils. The Carr soils are loamy, and the McCook soils are silty. They are on flood plains or terraces in slightly higher positions than the Invale soil.

Permeability is rapid, and runoff is slow. The available water capacity is low. The content of organic matter and natural fertility are low. The surface layer is mildly alkaline.

Most areas of this soil are used as range. The soil generally is not suited to cultivated crops because flooding, drought, and soil blowing are severe hazards. A cover of range plants effectively controls soil blowing and conserves moisture. The native vegetation is dominantly sand bluestem and little bluestem. However, in many areas the range has been invaded by eastern cottonwood and brush. Proper stocking rates, timely deferment of grazing, and control of unwanted vegetation help maintain or increase forage production.

The vegetation common to this soil provides habitat for many types of wildlife, including quail, deer, rabbit, and numerous songbirds. Wildlife populations can be increased by providing more areas where range is adjacent to forest and cropland.

This soil is generally not suited to building site development because of the hazard of flooding. It is difficult to overcome this limitation; major flood control measures are required.

This soil is in capability subclass VIw.

In—Inavale loamy fine sand. This is a deep, undulating, somewhat excessively drained soil on flood plains. It is occasionally flooded. Individual areas are irregular in shape and range from 10 to 40 acres in size.

Typically, the surface layer is grayish brown, calcareous loamy fine sand about 9 inches thick. The layer below that is grayish brown, very friable, calcareous loamy fine sand about 10 inches thick. The substratum to a depth of about 60 inches is calcareous. The upper part is pale brown loamy fine sand; the middle part is grayish brown and very pale brown fine sandy loam and very fine sandy loam; and the lower part is pale brown loamy fine sand.

Included with this soil in mapping and making up less than 10 percent of the map unit are small areas of Carr soils. The Carr soils are loamy and are on slightly higher flood plains than the Inavale soil.

Permeability is rapid, and runoff is slow. The available water capacity is low. The content of organic matter and natural fertility are low. The surface layer is mildly alkaline. It is very friable.

About half of the acreage of this soil is in cultivated crops. The rest is used as rangeland. This soil is poorly

suited to cultivated crops. Wheat, grain sorghum, forage sorghum, and alfalfa are the main crops. If this soil is cultivated, soil blowing and droughtiness are hazards. Use of cover crops, stripcropping, and minimum tillage help reduce soil blowing. Low fertility is also a concern in management. Crop residue left on the surface helps maintain the content of organic matter, improve fertility, and conserve moisture.

In range, the native vegetation is dominantly sand bluestem and little bluestem. If the range is overgrazed, vegetative cover is reduced, the plant community deteriorates, and the taller grasses are replaced by less productive grasses and weeds, for example, windmillgrass, annual ragweed, and blue grama. Proper stocking rates, uniform distribution of grazing, and timely deferment of grazing help keep the range in good condition. Range seeding is needed to restore productivity on abandoned cropland.

This soil is generally not suited to building site development because of the hazard of flooding. It is difficult to overcome this limitation; major flood control measures are required.

This soil is in capability subclass IVe.

Ke—Kenesaw silt loam, 6 to 11 percent slopes. This is a deep, strongly sloping, well drained soil on side slopes on uplands. Individual areas of this soil are irregular in shape and range from 10 to 80 acres in size.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is pale brown, friable silt loam about 10 inches thick. The substratum to a depth of about 60 inches is very pale brown silt loam and is calcareous below a depth of 34 inches. In a few places the subsoil is silty clay loam.

Permeability is moderate, and runoff is medium. The available water capacity is high. The content of organic matter is moderate, and natural fertility is high. The surface layer is neutral. Tilth is good.

About half of the acreage of this soil is in cultivated crops. The rest is used as rangeland. This soil is poorly suited to cultivated crops. Wheat, grain sorghum, and forage sorghum are the main crops. If cultivated crops are grown, erosion is a hazard. Terraces, grassed waterways, contour farming, stubble mulching, and minimum tillage help reduce runoff. Crop residue returned to the soil increases water infiltration and helps maintain the content of organic matter and improve tilth.

On rangeland, the native vegetation is dominantly big bluestem, little bluestem, indiangrass, and switchgrass. If the range is continually overgrazed, the most productive grasses are replaced by less desirable plants, for example, blue grama, buffalograss, and western ragweed. Proper stocking rates, timely deferment of grazing, and uniform distribution of grazing help keep the range in good condition.

This soil is moderately well suited as a site for dwellings and local roads and streets. Slope is a limitation for these uses. Some land shaping is commonly needed to prepare a building site. Cutting and filling may be needed on sites for roads. Road cuts should be seeded to adapted grasses. Low strength is an additional limitation for local roads and streets. Roads and streets need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength. Coarser grained base material can be used to insure better performance.

The soil is moderately well suited to use as septic tank absorption fields and poorly suited as a site for sewage lagoons. Slope is a limitation for these uses. Lateral lines for absorption fields should be constructed on the contour. Land shaping is necessary in preparing a site for sewage lagoons. If a less sloping area is selected as a site for the lagoon, less leveling and banking are required. Seepage can be an additional problem for sewage lagoons. Sealing the lagoon helps reduce seepage.

This soil is in capability subclass IVe.

Mc—McCook silt loam. This is a deep, nearly level, well drained soil on terraces along major streams. It is rarely flooded. Individual areas are irregular in shape and range from 50 to 100 acres in size.

Typically, the surface layer is light brownish gray, calcareous silt loam about 6 inches thick. The subsurface layer is grayish brown, very friable, calcareous silt loam about 10 inches thick. The layer below that is light brownish gray, very friable, calcareous silt loam about 6 inches thick. The substratum to a depth of about 60 inches is light gray and calcareous. In the upper part it is silt loam, and in the lower part it is very fine sandy loam. In a few places the subsoil is fine sandy loam.

Permeability is moderate, and runoff is slow. The available water capacity is high. The content of organic matter is moderate. Natural fertility is high. The soil is mildly alkaline or moderately alkaline throughout. The surface soil is very friable, and tilth is good.

This soil is used mainly for cultivated crops. It is well suited to dryland and irrigated crops. Wheat, sorghum, and alfalfa are the main crops grown in dryland areas. The main concern in management is conserving moisture. Minimum tillage and crop residue left on the surface help maintain fertility and the content of organic matter and conserve moisture.

In irrigated areas, corn and grain sorghum are the main crops. The main management concerns are using irrigation water efficiently and maintaining the content of organic matter, fertility, and tilth. Crop residue left on the surface helps maintain the content of organic matter, fertility, and tilth. Land leveling and water management help improve water distribution.

This soil is poorly suited as a site for dwellings because of flooding. Protecting the soil from flooding by dikes, levees, and other structures reduces this hazard.

Onsite inspection and knowledge of an area's flooding history are necessary in selecting suitable building sites. The soil is moderately well suited to local roads and streets. Constructing roads on raised, well-compacted fill material and providing adequate side ditches and culverts help protect them from flooding and frost damage.

This soil is moderately well suited to use as septic tank absorption fields and as a site for sewage lagoons. The hazard of flooding can be a problem for septic tank systems. Levees reduce this hazard. Seepage is a limitation for sewage lagoons. Sealing the lagoon helps reduce seepage.

This soil is in capability class I.

Nc—New Cambria silty clay. This is a deep, nearly level, moderately well drained soil on slightly concave terraces. It is rarely flooded. Individual areas are irregular in shape and range from 40 to 100 acres in size.

Typically, the surface layer is gray, calcareous silty clay about 4 inches thick. The subsurface layer is dark gray, very firm, calcareous silty clay about 11 inches thick. The subsoil is gray, very firm, calcareous silty clay about 23 inches thick. The substratum to a depth of about 60 inches is grayish brown, mottled, calcareous silty clay loam. In some places the surface layer is noncalcareous silty clay loam.

Included with this soil in mapping and making up about 5 percent of the map unit are small areas of Roxbury soils. The Roxbury soils are well drained. They have a less clayey subsoil and are on slightly higher terraces than the New Cambria soil.

Permeability and runoff are slow. The available water capacity is moderate. The content of organic matter is moderate, and natural fertility is high. The surface layer is mildly alkaline or neutral. Tilth is poor. The subsoil has high shrink-swell potential.

This soil is used mainly for cultivated crops. It is moderately well suited to dryland and irrigated crops. Wheat, grain sorghum, forage sorghum, and alfalfa are the main crops in dryland areas. Planting and tillage are sometimes delayed during wet periods. Drainage ditches help remove excess surface water. Minimum tillage and crop residue returned to the soil help improve tilth and increase water infiltration.

In irrigated areas, corn and grain sorghum are the main crops. The main management concerns are using irrigation water efficiently and maintaining the content of organic matter and fertility. Crop residue left on the surface effectively maintains fertility. Land leveling and water management help improve water distribution.

The soil generally is not suited to building site development because of the hazard of flooding. This limitation is difficult to overcome; major flood control measures are required.

This soil is in capability subclass IIs.

Nd—Nibson silt loam, 5 to 25 percent slopes. This is a shallow, moderately sloping to moderately steep, somewhat excessively drained soil on upland ridges and side slopes. Individual areas are irregular in shape and range from 5 to several hundred acres in size.

Typically, the surface layer is very dark gray, calcareous silt loam about 10 inches thick. The subsoil is light brownish gray, friable, calcareous silty clay loam about 5 inches thick. The substratum is white, calcareous silty clay loam. White, chalky shale and limestone are at a depth of about 19 inches. In some places the surface layer is shaly silt loam.

Included with this soil in mapping and making up about 10 percent of the map unit are small areas of Armo and Wakeen soils and limestone outcrops. The Armo soils are deep and are on the lower side slopes. The Wakeen soils are moderately deep and are on upper side slopes. Limestone outcrops are on steep breaks.

Permeability is moderate, and runoff is rapid. The available water capacity is low. The content of organic matter is moderately low, and natural fertility is low. The surface layer is moderately alkaline. Root development is restricted below a depth of about 19 inches. The subsoil has moderate shrink-swell potential.

This soil is used mainly as rangeland. This soil generally is not suited to cultivated crops because erosion is a severe hazard. The major concerns in range management are the hazard of erosion and the low available water capacity. The native vegetation is dominantly big bluestem, little bluestem, and sideoats grama. If the range is overgrazed, the vegetative cover is reduced, the plant community deteriorates, and the most desirable grasses are replaced by less productive grasses and weeds. An adequate plant cover helps prevent excessive soil loss and increases water infiltration. Proper stocking rates, uniform grazing distribution, and timely deferment of grazing help keep the range in good condition. In some of the large areas this soil is suited to use as a site for stockwater ponds.

This soil is poorly suited as a site for dwellings and for local roads and streets because of the moderately steep slopes. Depth to bedrock is an additional limitation for dwellings with basements. In most places, the rock is soft and can easily be excavated. Low soil strength can be a problem if this soil is used for roads and streets. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength. If roads and dwellings are constructed in smoother, less sloping areas, less land shaping is required.

This soil generally is not suitable for sewage disposal systems because of slope and shallow depth to bedrock. The included deep soils on lower side slopes are better suited to use as a site for sewage disposal systems.

This soil is in capability subclass VIe.

Nr—Nuckolls-Roxbury silt loams, 0 to 30 percent slopes. This map unit consists of deep, well drained soils along upland drainageways. It is about 75 percent Nuckolls soils, 20 percent Roxbury soils, and 5 percent included soils. Areas of Nuckolls and Roxbury soils are so intricately mixed or so small that it was not practical to map them separately. Individual areas of this map unit are long and irregular in shape and range from 20 to several hundred acres in size.

The Nuckolls soil is strongly sloping to steep. It is on side slopes. Typically, the surface layer is grayish brown silt loam about 10 inches thick. The subsoil is friable silty clay loam about 24 inches thick. In the upper part it is dark grayish brown, and in the lower part it is light yellowish brown. The substratum to a depth of about 60 inches is light brown, calcareous silt loam.

The Roxbury soil is nearly level. It is on flood plains and is frequently flooded. Typically, the surface layer is grayish brown, calcareous silt loam about 6 inches thick. The subsurface layer is dark grayish brown, friable, calcareous silt loam about 18 inches thick. The subsoil is dark grayish brown, friable, calcareous silt loam about 18 inches thick. The substratum to a depth of about 60 inches is light gray, calcareous silt loam.

Included with these soils in mapping are small areas of Wakeen soils and chalky shale outcrops. The Wakeen soils are moderately deep and are on lower side slopes. The chalky shale outcrops are on steep side slopes.

Permeability is moderate in both Roxbury and Nuckolls soils, and the available water capacity is high. Runoff is rapid on the Nuckolls soil and slow on the Roxbury soils. The content of organic matter is moderate in both soils. Natural fertility is medium in the Nuckolls soil and high in the Roxbury soil. The surface layer of the Nuckolls soil is neutral, and the Roxbury soil is mildly alkaline throughout. The subsoil of both soils has moderate shrink-swell potential.

In most areas these soils are used for range. In a few small areas the Roxbury soil is cultivated. The soils in this map unit generally are not suited to cultivated crops because of frequent flooding on the Roxbury soil and the severe hazard of erosion on the Nuckolls soil.

On rangeland, the native vegetation on the Nuckolls soil is dominantly little bluestem and big bluestem. In many areas of the Roxbury soil the range is overgrazed and is in poor condition. The most desirable grasses have been replaced by less productive grasses and weeds. These areas are near watering facilities and shade trees where livestock congregate. Placing salt blocks on the steep side slopes helps improve distribution of grazing.

The vegetation common to these soils provides habitat for many wildlife species, including quail, deer, rabbits, and numerous songbirds. Wildlife populations can be increased by providing more areas where range is adjacent to forest or cropland.

These soils generally are not suited to building site development because of the hazard of flooding on the Roxbury soil and the steep slopes of the Nuckolls soil.

These soils are in capability subclass VIe.

Pt—Pits, quarries. This map unit consists of areas from which the soil and some of the underlying limestone have been removed. The underlying material has been quarried for use in manufacturing cement. Individual areas are irregular in shape and range from 40 to 400 acres in size.

A typical quarry is a pit surrounded by a vertical wall 8 to 30 feet high. Small piles of limestone rock and mounds of overburden material are scattered over the mined area and around the outer edge of the pit.

This map unit is not suited to cultivation or to most other uses. The surface generally is bare. There are scattered trees, shrubs, and clumps of grass on the overburden material that is scattered throughout the older areas of the quarry. Cottonwood trees are common invaders in abandoned excavations.

This map unit has limited potential for most uses unless the areas are reclaimed. In formerly mined areas, the overburden can be leveled or smoothed and vegetation reestablished. Big bluestem, little bluestem, indiangrass, and switchgrass are suitable. If vegetation has been reestablished, the pits are well suited to use as wildlife habitat.

This map unit is not assigned to a capability subclass.

Ra—Roxbury silt loam. This is a deep, nearly level, well drained soil on terraces along major streams. It is rarely flooded. Individual areas of this soil are irregular in shape and range from 20 to several hundred acres in size.

Typically, the surface layer is grayish brown, calcareous silt loam about 6 inches thick. The subsurface layer is dark grayish brown, friable, calcareous silt loam about 18 inches thick. The subsoil is grayish brown, friable, calcareous silt loam about 12 inches thick. The substratum to a depth of about 60 inches is calcareous. In the upper part it is light brownish gray silty clay loam, and in the lower part it is light gray silt loam. In some places the surface layer and subsoil are noncalcareous. In some places the substratum has fragments of chalky limestone.

Permeability is moderate, and runoff is slow. The available water capacity is high. The content of organic matter is moderate, and natural fertility is high. The soil is mildly alkaline or moderately alkaline. Tilth is good. The subsoil has moderate shrink-swell potential.

This soil is used mainly for cultivated crops. It is well suited to dryland and irrigated crops. Wheat, sorghum, and alfalfa are the main crops in dryland areas. The main concern in management is conserving moisture. Minimum tillage and crop residue left on the surface help

maintain fertility and the content of organic matter and conserve moisture.

In irrigated areas, corn and grain sorghum are the main crops. The main management concerns are using irrigation water efficiently and maintaining soil fertility. Crop residue left on the surface effectively maintains tilth and fertility. Land leveling and water management can increase the efficiency of irrigation.

This soil is poorly suited as a site for dwellings because of the hazard of flooding. Protecting the soil from flooding by dikes, levees, and other structures reduces this hazard. Onsite inspection and knowledge of an area's flooding history are needed to select suitable building sites. The soil is moderately well suited to local roads and streets. Low strength is a limitation. Roads and streets need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength. Coarser grained base material can be used to insure better performance. Constructing roads on raised, well compacted fill material and providing adequate side ditches and culverts reduce the risk of damage from flooding.

This soil is moderately well suited to use as septic tank absorption fields and for sewage lagoons. The hazard of flooding is a problem for septic tank systems. Levees reduce this hazard. Seepage is a limitation for sewage lagoons. Sealing the lagoon helps reduce seepage.

This soil is in capability class I.

Rb—Roxbury silt loam, channeled. This is a deep, nearly level, well drained soil on flood plains of small creeks and intermittent drainageways. It is frequently flooded. Individual areas are typically narrow and elongated. They range from 100 to 500 feet in width, 600 to 7,000 feet in length, and 5 to 100 acres in size.

Typically, the surface layer is dark grayish brown, calcareous silt loam about 22 inches thick. The subsoil is grayish brown, friable, calcareous silt loam about 12 inches thick. The substratum to a depth of about 60 inches is light gray, calcareous silt loam. In some places the substratum is stratified with limestone pebbles, generally below a depth of 40 inches.

Included in mapping and making up about 5 percent of the map unit are small areas of Gibbon and New Cambria soils. These soils are on slightly lower flood plains. The Gibbon soil is somewhat poorly drained, and the New Cambria soil is clayey.

Permeability is moderate, and runoff is slow. The available water capacity is high. The content of organic matter is moderate, and natural fertility is high. The soil is mildly alkaline or moderately alkaline. The subsoil has moderate shrink-swell potential.

In most areas this soil is used for range. It generally is not suited to cultivated crops because of the hazard of flooding. In addition, operating farm machinery along the meandering stream channel is difficult. This soil is well suited to range. However, in many areas near watering facilities and shade trees where livestock congregate, the range is overgrazed and in poor condition. In these areas, the most desirable grasses have been replaced by less productive grasses and weeds. Proper stocking rates, uniform distribution of grazing, and timely deferment of grazing help keep the range in good condition.

The vegetation common to this soil provides habitat for many wildlife species, including quail, deer, rabbits, and numerous songbirds. Wildlife populations can be increased by providing more areas where range is adjacent to forest or cropland.

This soil generally is not suited to building site development because of the hazard of flooding. It is difficult to overcome this limitation; major flood control measures are required.

This soil is in capability subclass Vw.

Rc—Roxbury silt loam, occasionally flooded. This is a deep, nearly level, well drained soil on flood plains of creeks and intermittent drainageways (fig. 10). It is occasionally flooded for very brief periods. Individual areas range from 200 to 600 feet in width, one-fourth mile to more than 2 miles in length, and 10 to 200 acres in size.

Typically, the surface layer is dark grayish brown, calcareous silt loam about 6 inches thick. The subsurface layer is dark grayish brown, friable, calcareous silt loam about 18 inches thick. The subsoil is grayish brown, friable, calcareous silt loam about 12 inches thick. The substratum to a depth of about 60 inches is light gray, calcareous silt loam. In some places the subsoil is stratified with limestone gravel below a depth of 40 inches.

Included with this soil in mapping and making up about 10 percent of the map unit are small areas of Gibbon soils. The Gibbon soils are somewhat poorly drained and are on slightly lower flood plains than the Roxbury soil.

Permeability is moderate, and runoff is slow. The available water capacity is high. The content of organic matter is moderate, and natural fertility is high. The soil is mildly alkaline or moderately alkaline. The subsoil has moderate shrink-swell potential.

About half of the acreage of this soil is cultivated. The rest is used as rangeland. The soil is well suited to wheat, grain sorghum, forage sorghum, and alfalfa. Crop yields are reduced in some years because of flooding; however, in other years extra moisture increases crop production. Dikes and diversions help reduce damage caused by flooding. Crop residue returned to the soil improves water infiltration and helps maintain the content of organic matter, fertility, and good tilth.

This soil is well suited to range. However, in many areas the range is overgrazed and in poor condition. In these areas, the most desirable grasses have been replaced by less productive grasses and weeds. Proper

Figure 10.—Many areas of Roxbury silt loam, occasionally flooded, are used for range. Geary silt loam is on the adjacent uplands.

stocking rates, timely deferment of grazing, and uniform distribution of grazing help keep the range in good condition. Placing salt blocks on the adjacent steeper soils helps improve distribution of grazing.

This soil generally is not suited to building site development because of the hazard of flooding. This limitation is difficult to overcome; major flood control measures are required.

This soil is in capability subclass IIw.

Sa—Saltine silty clay loam. This is a deep, nearly level, poorly drained soil on flood plains. It is frequently flooded. Most of this soil is in one elongated area in the southeastern part of the county.

Typically, the surface layer is gray, calcareous silty clay loam about 12 inches thick. The subsurface layer is gray, firm, calcareous silty clay loam about 18 inches thick. The substratum to a depth of about 60 inches is calcareous silty clay loam. The upper part is grayish brown, and the lower part is light brownish gray and has yellowish brown mottles.

Included with this soil in mapping and making up about 10 percent of the map unit are small areas of the somewhat poorly drained Gibbon soils and the well drained Roxbury soils. These soils are in slightly higher positions on the landscape than the Saltine soil.

Permeability is moderately slow, and runoff is very slow. The available water capacity is moderate. The content of organic matter is moderate, and natural fertility is low. The surface layer is mildly alkaline. The content of sodium and soluble salts is high enough to adversely affect the growth of most plants. Depth to a seasonal high water table ranges from 2 to 3 feet.

This soil is used mainly as rangeland. It generally is not suited to cultivated crops because of the saline-alkali condition and the hazard of flooding. This soil is best suited to use as rangeland. The growth and composition of the grasses vary because of differences in the degree of salinity and content of sodium. Distribution of livestock can be improved by proper placement of fences and water facilities.

The soil has good potential for use as habitat for wetland wildlife. Excavated ponds provide habitat for waterfowl.

This soil generally is not suited to building site development because of the hazard of flooding. It is difficult to overcome this limitation; major flood control measures are required.

This soil is in capability subclass VIs.

Wc—Wakeen silt loam, 3 to 7 percent slopes. This is a moderately deep, moderately sloping, well drained soil on side slopes and ridgetops. Areas of this soil are irregular in shape and range from 15 to 80 acres in size.

Typically, the surface layer is gray, calcareous silt loam about 10 inches thick. The subsoil is about 24 inches thick. The upper part is light brownish gray, friable, calcareous silty clay loam; the lower part is very pale brown, friable, calcareous silty clay loam. Chalky shale is at a depth of about 34 inches. In some places shale bedrock is at a depth of more than 40 inches.

Included with this soil in mapping and making up about 10 percent of the unit are small areas of Nibson soils. The Nibson soils are shallow and are on the lower part of some slopes.

Permeability is moderate, and runoff is medium. The available water capacity is moderate. The content of organic matter is moderate, and natural fertility is medium. The surface layer is mildly alkaline to moderately alkaline. Tilth is good. The subsoil has moderate shrink-swell potential.

About half of the acreage of this soil is cultivated. Most of the rest is used as rangeland. This soil is moderately well suited to wheat, grain sorghum, forage sorghum, and alfalfa. Sorghum may develop chlorosis because of the high content of lime in the soil. Erosion and drought are hazards. Terracing, contour farming, and minimum tillage help reduce runoff and excessive soil loss. Crop residue returned to the soil increases the water intake rate and helps maintain the content of organic matter, fertility, and good tilth. The included shallow Nibson soil is difficult to till and can cause damage to tillage implements.

In rangeland, the native vegetation is dominantly big bluestem, little bluestem, and sideoats grama. If the range is overgrazed, the plant cover is reduced, and the most desirable grasses are replaced by less productive grasses. Maintaining an adequate plant cover helps reduce runoff and prevent excessive soil loss. Proper stocking rates, uniform distribution of grazing, and timely deferment of grazing help keep the range in good condition. Range seeding is needed to restore productivity on abandoned cropland. Some areas that were once cultivated have been seeded back to grass.

This soil is moderately well suited to local roads and streets and dwellings. Low strength is a problem if the soil is used for roads and streets. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength. Shrinking and swelling of the soil can damage houses and other buildings. Such damage can be prevented or minimized if the building is properly designed and the foundation is reinforced. Depth to bedrock is an additional limitation for dwellings with basements. In some places the rock is soft and can easily be excavated.

This soil generally is not suited to use as septic tank absorption fields and poorly suited as a site for sewage lagoons because of depth to bedrock. Because of the moderate depth to shale bedrock, the construction of sewage lagoons requires bringing fill in or ripping the rock. The bottom of the lagoon may need to be sealed to prevent excess seepage into fractures in the bedrock. The included soils on the lower side slopes provide favorable sites for absorption fields and sewage lagoons because they are deep.

This soil is in capability subclass IVe.

Wd—Wakeen silt loam, 7 to 20 percent slopes. This is a moderately deep, strongly sloping and moderately steep, well drained soil on side slopes and ridgetops. Areas of this soil are irregular in shape and range from 15 to 120 acres in size.

Typically, the surface layer is dark grayish brown, calcareous silt loam about 10 inches thick. The subsoil is friable, calcareous silty clay loam about 22 inches thick. In the upper part it is grayish brown, and in the lower part it is very pale brown. Very pale brown chalky shale is at a depth of about 30 inches. In some places the depth to shale bedrock is more than 40 inches.

Included with this soil in mapping and making up about 15 percent of the map unit are small areas of Brownell soils and chalky shale outcrops. The Brownell soils are gravelly and are on side slopes. The chalky shale outcrops are barren and are on the steeper side slopes (fig. 11).

Permeability is moderate, and runoff is rapid. The available water capacity is moderate. The content of organic matter is moderately low, and natural fertility is medium. The surface layer is mildly alkaline or moderately alkaline. It is friable, and tilth is good. Root development is restricted below a depth of about 30 inches. The subsoil has moderate shrink-swell potential.

This soil is used mainly as rangeland. It generally is not suited to cultivated crops because erosion is a severe hazard. On rangeland the native vegetation is dominantly big bluestem, little bluestem, and sideoats grama. If the range is overgrazed, the most desirable grasses are replaced by less productive plants, for example, blue grama and tall dropseed. Proper stocking rates help keep the range in good condition. In some of the steeper areas the range is infrequently used by livestock. Proper placement of water and salt facilities and of fences helps improve distribution of grazing.

Figure 11.—Chalky shale outcrops are included in areas of Wakeen silt loam, 7 to 20 percent slopes.

This soil is moderately well suited to use for local roads and streets and dwellings. Low strength is a problem if the soil is used for roads and streets. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength. Shrinking and swelling of the soil can damage houses and other buildings. Such damage can be prevented or minimized if the building is properly designed and the foundation is reinforced. Depth to bedrock is an additional limitation for dwellings with basements. In some places the rock is soft and can easily be excavated. If a less sloping area is selected as a site for dwellings, less land shaping is needed.

This soil generally is not suited as a site for sewage disposal systems because of depth to bedrock. The deeper, less sloping soils on the upper and lower parts of some side slopes are more suitable.

This soil is in capability subclass VIe.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and federal levels, as well as individuals, must encourage and facilitate the wise use of our nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to producing food, feed, forage, fiber, and oilseed crops. Such soils have properties that are favorable for the economic production of sustained high yields of crops. The soils need only to be treated and managed using acceptable farming methods. The moisture supply, of course, must be adequate, and the growing season has to be sufficiently long. Prime farmland soils produce the highest yields with minimal inputs of energy and economic resources, and farming these soils results in the least damage to the environment.

Prime farmland soils may presently be in use as cropland, pasture, or woodland, or they may be in other uses. They either are used for producing food or fiber or are available for these uses. Urban or built-up land and water areas cannot be considered prime farmland.

Prime farmland soils usually get an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The acidity or alkalinity level of the soils is acceptable. The soils have few or no rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not subject to frequent flooding during the growing season. The slope ranges mainly from 0 to 6 percent.

Soils that have a high water table, are subject to flooding, or are droughty may qualify as prime farmland soils if the limitations or hazards are overcome by drainage, flood control, or irrigation. Onsite evaluation is necessary to determine the effectiveness of corrective measures. More information on the criteria for prime farmland soils can be obtained at the local office of the Soil Conservation Service.

About 394,000 acres, or 67 percent of the county, is prime farmland. The largest areas are in soil associations 1, 2, 3, and 5 on the general soil map. Many scattered areas of prime farmland are in the other soil associations. About 325,000 acres of this prime farmland is presently used for crops.

A recent trend in land use in some parts of the county has been the conversion of some prime farmland to urban and industrial uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are wet, more erodible, droughty, or difficult to cultivate and less productive than prime farmland.

The following map units, or soils, make up prime farmland in Jewell County. On some soils included in the list, appropriate measures have been applied to overcome a hazard or limitation, such as flooding, wetness, or droughtiness. The location of each map unit is shown on the detailed soil maps at the back of this publication. The extent of each unit is given in table 4. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units." This list does not constitute a recommendation for a particular land use.

Ao	Armo loam, 1 to 3 percent slopes
Ar	Armo loam, 3 to 7 percent slopes
Ca	Carr fine sandy loam
Cr	Crete silt loam, 0 to 1 percent slopes
De	Detroit silty clay loam
Ge	Geary silt loam, 3 to 7 percent slopes
Gf	Geary silty clay loam, 3 to 7 percent slopes, eroded
Gn	Gibbon silty clay loam (where drained)
Ha	Harney silt loam, 0 to 1 percent slopes
Hb	Harney silt loam, 1 to 3 percent slopes
Hf	Harney silty clay loam, 3 to 7 percent slopes, eroded
Ho	Holdrege silt loam, 3 to 7 percent slopes
Hr	Holdrege silty clay loam, 3 to 7 percent slopes, eroded
Hu	Hord silt loam
Mc	McCook silt loam
Nc	New Cambria silty clay
Ra	Roxbury silt loam
Rc	Roxbury silt loam, occasionally flooded

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

John C. Dark, conservation agronomist, Soil Conservation Service, assisted in preparing this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soil, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Approximately 65 percent of Jewell County is used for cultivated crops. Wheat is the main crop (fig. 12). During the 1970's, wheat was produced on about 41 percent of the crop acreage, sorghum on 30 percent, and alfalfa on 6 percent (*3*). Other crops, including corn, oats, barley, and soybeans, were grown on about 11 percent of the acreage. About 12 percent of the cropland was in summer fallow.

The acreage of sorghum and wheat increased slightly between 1969 and 1979. The acreage of all of the other crops remained constant or declined during this period.

Approximately 12,000 acres in the county is irrigated. Most of the acreage used for corn is irrigated.

The main considerations in managing the soils for crops are controlling erosion, using available water efficiently, and maintaining soil fertility.

Soil erosion is the major problem on about 84 percent of the cropland in Jewell County. If the surface layer is lost through erosion, the available plant nutrients and the organic matter, which have a positive effect on structure, water infiltration, available moisture capacity, and general tilth, also are lost. In many areas soil erosion on farmland results in the pollution of streams by sediment, nutrients, and pesticides. Controlling erosion minimizes this pollution and improves the quality of water.

Erosion can be controlled effectively by using conservation practices. Terraces help reduce the slope length and control runoff, thus reducing erosion from water. Crop residue left on the surface effectively increases the infiltration rate and decreases the amount of runoff. Other practices that reduce erosion are diversions, contour farming, grassed waterways, and a cropping system that includes close growing crops.

Organic matter, in addition to providing available nutrients, increases the water intake rate, reduces surface crusting, reduces soil losses from erosion, and promotes good tilth. Many of the soils in the survey area that are used for crops have a surface layer of silt loam or loam. On these soils, intensive rainfall causes the

Figure 12.—Winter wheat on Harney silt loam, 1 to 3 percent slopes. Wheat is the main crop in Jewell County.

surface to crust. When dry, the crusted surface becomes hard and nearly impervious to water, resulting in increased runoff. Regularly adding organic material helps improve soil structure and reduce crust formation. Crop residue left on the surface also helps prevent crust formation.

Terraces and diversions reduce the length of slopes and thereby reduce the rate of runoff and the hazard of erosion. They are most practical on deep, well drained soils that have uniform, regular slopes. Many of the cropland soils in the county are suitable for terraces and diversions.

Soil blowing is a hazard on the sandy Carr and Inavale soils. Maintaining plant cover, adding surface mulch, or roughening the surface through tillage minimizes soil blowing on these soils.

Information on erosion control practices for each kind of soil is available at the local office of the Soil Conservation Service.

Most of the arable soils in the county respond well to nitrate and phosphate fertilizer. On all of the soils the amount of fertilizer used should be based on soil tests, the crop needs, expected yield, and on past yields. The Cooperative Extension Service can help determine the kind and amount of fertilizer and lime to apply.

The main concern in managing the soils in the county for tame grass is maintaining or improving the quality and quantity of forage. Proper stocking rates, rotation grazing, proper placement of water and salt, fertilization, and control of unwanted vegetation help maintain a good stand of tame grasses. Smooth bromegrass is the main grass used in pastures.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Rangeland

Kenneth L. Hladek, range conservationist, Soil Conservation Service, assisted in preparing this section.

Approximately 26 percent of Jewell County, or 153,000 acres, is rangeland. Approximately 30 percent of the agricultural income is derived from livestock, principally cattle.

Many of the livestock operations in Jewell County are composed of small, stock-farm units. This type of unit is

especially common in the more northern and southern parts of the county, where small areas of rangeland are interspersed with larger areas of cropland. Larger, ranch-type operations prevail in the central section of the county, where the areas of rangeland are generally larger and more contiguous.

The potential natural plant community, based on the characteristics of the soils and the amount of precipitation received, is a mixed grass prairie, typically dominated by bluestem and grama. A few producers extend the grazing season by planting cool season grasses, principally bromegrass. Range forage generally is supplemented by crop residue from grain sorghum. During the winter, hay and protein concentrates are generally used.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 6 shows, for each soil listed, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as rangeland or are suited to use as rangeland are listed. Explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, reduction of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

One of the major concerns on rangeland in Jewell County is controlling grazing in order to maintain or improve the principal grass species in the natural plant community. Forage production has been reduced in many areas because the natural plant community has been depleted by excessive continuous grazing. Proper grazing use and good grazing distribution are needed to maintain productive rangeland. Range in most places can be improved by a system of planned or deferred grazing, weed and brush control, and reseeding of marginal or abandoned cropland.

Windbreaks, Environmental Plantings, and Native Woodlands

Keith A. Ticknor, forester, Soil Conservation Service, assisted in preparing this section.

In addition to the windbreaks and shelterbelts in Jewell County, there are irregular strips of woodland on the river bottoms and along the streams and upland drainageways and some fairly large blocks of woodland in the northern part of the county, in the Brownell-Wakeen-Bogue soil association.

The trees and shrubs in the drainageways and along the rivers are primarily eastern cottonwood, boxelder, green ash, hackberry, red mulberry, silver maple,

Figure 13.—A newly planted windbreak in an area of Crete silt loam, 0 to 1 percent slopes. Windbreaks protect farmsteads and provide habitat for wildlife.

American and red elms, black willow, bur oak, black walnut, honeylocust, Kentucky coffeetree, common chokecherry, and American plum. Woodland on the large bottomlands, such as those of the Republican River, is made up mainly of cottonwood. Woodland in the upland drainageways is made up mainly of green ash, bur oak, and hackberry.

Several of the tree species in the county, especially black walnut, bur oak, green ash, and eastern cottonwood, have commercial value. Other lower quality species are valuable for firewood. Most of the soils that are suited to trees are presently used as cropland. Very little woodland is managed for commercial wood production because most of the areas are privately owned and make up only a small part of a farm unit. Odd isolated areas or small, hard-to-farm fields have the greatest potential for conversion to woodland.

On most farmsteads and ranch headquarters in Jewell County, eastern redcedar and Siberian elm are the most common species in the older windbreaks. Rocky Mountain juniper, honeylocust, green ash, hackberry, eastern cottonwood, ponderosa pine, Austrian pine, and lilac also are used in windbreaks.

Tree planting around farmsteads is a continuing process. Old trees deteriorate, some trees are lost because of insects and disease, and others are destroyed by storms. New windbreaks are needed on expanding farmsteads (fig. 13).

Field windbreaks or shelterbelts are fairly common throughout the county. Many of the field windbreaks consist of 8 to 10 rows of trees and shrubs. In addition, there are numerous hedgerows of osageorange. These hedgerows mark property lines and are a source of fenceposts.

The 8- to 10-row shelterbelts are made up of a variety of species. Some of the common species are eastern redcedar, hackberry, green ash, honeylocust, ponderosa pine, Russian mulberry, eastern cottonwood, black locust, osageorange, Siberian elm, black walnut, Russian-olive, bur oak, and American plum. Many of the older field windbreaks have reached maturity and are deteriorating. Renovation through thinning, removal, and replanting is needed to maintain the value and effectiveness of these windbreaks.

In order for windbreaks to fulfill their intended purpose and reach maximum growth, the species of trees or

shrubs selected must be adapted to the soils in the area. Permeability, the available water capacity, and fertility are soil characteristics that greatly affect the rate of growth of trees and shrubs in windbreaks.

Establishing trees and shrubs is somewhat difficult because of dry conditions and competition from other vegetation. Preparing the site properly before planting and controlling weed and grass competition after planting are important concerns in establishing and managing windbreaks. Supplemental watering is necessary during establishment.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

Recreation

Robert J. Higgins, biologist, Soil Conservation Service, assisted in preparing this section.

Lovewell Reservoir and State Park attracts a large number of visitors during the summer months, especially on weekends. Birdwatchers and wildlife photographers use the reservoir throughout the year to observe migrating waterfowl, shore birds, and often bald eagles. Good public facilities are provided for camping, fishing, boating, picnicking, and swimming.

Several other small lakes, including Jewell State Fishing Lake, are also used for recreation. Numerous farm ponds and streams provide opportunities for recreation on privately owned land. There are several areas of scenic, geologic, and historic interest in Jewell County.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent or its suitability as a site for a lagoon system and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the

depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Robert J. Higgins, biologist, Soil Conservation Service, assisted in preparing this section.

The primary game species in Jewell County are ring-necked pheasant, bobwhite quail, mourning dove, cottontail rabbit, white-tailed deer, and several species of waterfowl (fig. 14).

Furbearers, such as coyote, raccoon, muskrat, and beaver, are common along the streams and around Lovewell Reservoir. Ducks and geese are commonly seen at Lovewell Reservoir and on farm ponds.

Nongame wildlife are numerous throughout the county because of the diverse types of habitat available. Each type of habitat provides a home for a particular group of species. Areas of cropland, woodland, and grassland are intermixed, creating the desirable "edge" effect that is conducive to attracting a wide variety of species.

Stockwater ponds, streams, and Lovewell Reservoir provide good to excellent fishing during most of the year. The common species are largemouth bass, bluegill, channel cat, bullhead, and flathead catfish. Crappie, walleye, and white and striped bass are stocked at the reservoir.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, grain sorghum, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are the bluestems, goldenrod, western wheatgrass, switchgrass, sunflower, ragweed, native legumes, and the gramas.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, hackberry, elm, cottonwood, mulberry, black walnut, and ash. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, plum, fragrant sumac, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, redcedar, and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and

Figure 14.—Pheasant is a common game species on the uplands in Jewell County.

features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of native shrubs are gooseberry, dogwood, buckbrush, prairie rose, and chokecherry.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, cattails, indigobush, saltgrass, prairie cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild

herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, mourning dove, meadowlark, field sparrow, and cottontail rabbit.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, owls, hawks, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, opossum, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, redwinged blackbird, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include jackrabbit, deer, prairie dog, badger, meadowlark, and killdeer.

Technical assistance in planning wildlife habitat and in selecting suitable vegetation for plantings can be obtained from local offices of the Soil Conservation Service. Information and assistance also can be obtained from the Kansas Fish and Game Commission and from the Cooperative Extension Service.

Engineering

Glen Creager, Jr., civil engineer, Soil Conservation Service, assisted in preparing this section.

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations must be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to

bedrock or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Sanitary Facilities

Table 11 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on

the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plant growth. Material from the surface layer, therefore, should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement, permeability, depth to a high water table or depth of standing water if the soil is subject to ponding, slope, susceptibility to flooding, subsidence of organic layers, and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of wind

erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 17.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 17.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69.

The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, no more than once in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months;

November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An *artesian* water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Test Data

Table 17 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil Series and Their Morphology." The soil samples were tested by the Kansas Department of Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*6*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustolls (*Ust*, meaning intermittent dryness, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Argiustolls (*Argi*, meaning argillic horizon, plus *ustoll*, the suborder of the Mollisols that have a ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Argiustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, montmorillonitic, mesic Typic Argiustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*5*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*6*). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Armo Series

The Armo series consists of deep, well drained, moderately permeable soils on upland foot slopes. These soils formed in loamy and silty colluvium of chalky limestone. The slope ranges from 1 to 15 percent.

Armo soils are similar to Wakeen soils and are commonly adjacent to Bogue, Heizer, Nibson, and Roxbury soils. Wakeen soils are moderately deep to chalky shale and are in higher positions on the landscape than Armo soils. Bogue soils have more clay than Armo soils and are in lower positions. Heizer and Nibson soils are shallow to bedrock. They are generally

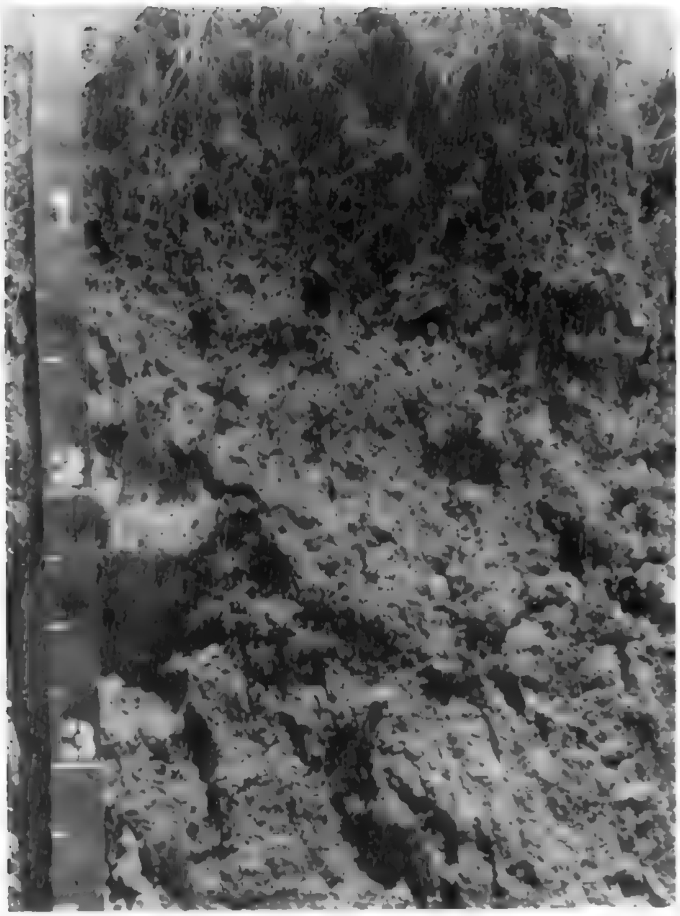


Figure 15.—Armo soils typically have a few chalk fragments throughout. Depth is shown in feet.

steeper and in higher positions on the landscape than Armo soils. Roxbury soils have a mollic epipedon that is more than 20 inches thick and are on terraces or flood plains.

Typical pedon of Armo loam, 1 to 3 percent slopes (fig. 15), 2,600 feet west and 200 feet north of the southeast corner of sec. 31, T. 2 S., R. 9 W.

Ap—0 to 6 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; moderate medium granular structure; slightly hard, friable; many fine roots; few wormcasts; about 2 percent fine chalk fragments; strong effervescence; mildly alkaline; clear smooth boundary.

A1—6 to 12 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; moderate fine granular structure; slightly hard, friable; many fine roots; few wormcasts; about 5 percent fine chalk fragments; strong effervescence; mildly alkaline; clear smooth boundary.

A2—12 to 16 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak coarse subangular blocky structure parting to moderate medium granular; hard, friable; many fine roots; about 2 percent chalk fragments; strong effervescence; mildly alkaline; clear smooth boundary.

Bw—16 to 30 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; slightly hard, friable; few fine roots; about 2 percent chalk fragments; violent effervescence; moderately alkaline; gradual wavy boundary.

C1k—30 to 42 inches; pale brown (10YR 6/3) gravelly clay loam, yellowish brown (10YR 5/4) moist; massive; hard, friable; few fine roots; porous; about 20 percent chalk fragments; violent effervescence; moderately alkaline; gradual wavy boundary.

C2—42 to 60 inches; pale brown (10YR 6/3) gravelly clay loam, brown (10YR 5/3) moist; massive; slightly hard, friable; few fine roots; strata of chalky limestone fragments; violent effervescence; moderately alkaline.

The solum is 20 to 40 inches thick. The mollic epipedon is 8 to 20 inches thick. Depth to lime ranges from 0 to 6 inches. The solum is mildly alkaline or moderately alkaline; however, in a few pedons the soil is neutral in the upper 6 inches.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 to 3. It is dominantly loam, although the range includes silt loam. The Bw horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is loam, clay loam, or silty clay loam. The C horizon has hue of 10YR. value of 6 or 7 (5 or 6 moist), and chroma of 2 to 4. It is loam, silt loam, clay loam, gravelly loam, gravelly clay loam, or very gravelly loam. Most of the pebbles are chalk fragments.

Bogue Series

The Bogue series consists of moderately deep, moderately well drained, very slowly permeable soils on uplands. These soils formed in residuum of clayey shale. The slope ranges from 3 to 15 percent.

Bogue soils are commonly adjacent to Armo, Corinth, Heizer, and New Cambria soils. Armo soils have a loamy subsoil. They are on side slopes in higher positions on the landscape than Bogue soils. Corinth soils have a less clayey subsoil and are on side slopes in lower positions. Heizer soils are shallow to limestone bedrock and are on side slopes in higher positions than Bogue soils. New Cambria soils are more than 40 inches deep to bedrock. They are on terraces.

Typical pedon of Bogue clay, in an area of Bogue-Armo complex, 3 to 15 percent slopes, 1,200 feet west and 200 feet south of the northeast corner of sec. 11, T. 5 S., R. 9 W.

A1—0 to 3 inches; gray (5Y 5/1) clay, dark gray (5YR 4/1) moist; weak very thick platy structure parting to weak fine subangular blocky, strong fine granular structure in upper 1/2 to 1 inch; very hard, very firm; many fine roots; few fragments of calcite; neutral; clear smooth boundary.

A2—3 to 8 inches; gray (5Y 5/1) clay, dark gray (10YR 4/1) moist; weak medium subangular blocky structure; very hard, very firm; few fine roots; few fragments of calcite; neutral; gradual smooth boundary.

AC—8 to 18 inches; gray (5Y 5/1) clay, dark gray (5Y 4/1) moist; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak coarse blocky structure; extremely hard, extremely firm; common fine roots; few slickensides; ped faces intersecting and inclined at a 20 to 30 degree angle from the horizontal; mildly alkaline; gradual wavy boundary.

C1—18 to 24 inches; olive gray (5Y 5/2) clay, olive gray (5Y 4/2) moist; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine angular blocky structure; extremely hard, extremely firm; few fine roots; common brownish yellow (10YR 6/6) shale fragments; very strongly acid; gradual smooth boundary.

C2—24 to 32 inches; olive gray (5Y 5/2) clay, olive gray (5Y 4/2) moist; common medium distinct brownish yellow (10YR 6/8) mottles; massive; extremely hard, extremely firm; very strongly acid; abrupt smooth boundary.

Cr—32 inches; gray (5Y 5/1) shale.

The solum is 12 to 23 inches thick. It ranges from neutral to moderately alkaline. Depth to shale ranges from 20 to 40 inches. Depth to lime varies. However, lime is always present as chalk or calcite fragments along old cracks.

The A horizon has hue of 10YR to 5Y, value of 4 to 7 (3 to 5 moist), and chroma of 1. It is clay or silty clay. The AC horizon has hue of 2.5Y or 5Y, value of 4 to 7 (3 to 5 moist), and chroma of 1 or 2. The C horizon has hue of 2.5Y or 5Y, value of 3 to 6 (2 to 4 moist), and chroma of 1 to 3. It is medium acid to very strongly acid.

Brownell Series

The Brownell series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in residuum of chalky limestone. The slope ranges from 3 to 15 percent.

Brownell soils are commonly adjacent to Heizer, Mento, and Wakeen soils. Heizer soils are less than 20 inches deep to limestone. They are steeper and are on side slopes in lower positions on the landscape than Brownell soils. Mento and Wakeen soils have few or no limestone fragments in the solum. They are in higher positions on the landscape than Brownell soils.

Typical pedon of Brownell gravelly loam, in an area of Brownell-Heizer gravelly loams, 3 to 30 percent slopes, 2,650 feet east and 100 feet north of the southwest corner of sec. 27, T. 4 S., R. 8 W.

A—0 to 8 inches; grayish brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; strong fine and medium granular structure; slightly hard, friable; many fine and medium roots; common wormcasts; about 30 percent fine limestone fragments; violent effervescence; moderately alkaline; gradual smooth boundary.

Bw—8 to 16 inches; grayish brown (10YR 5/2) very gravelly loam, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; slightly hard, friable; many fine and medium roots; common wormcasts; about 60 percent limestone fragments 1/2 inch to 3 inches in diameter; strong effervescence; moderately alkaline; gradual smooth boundary.

C—16 to 32 inches; very pale brown (10YR 7/4) very channery loam, light yellowish brown (10YR 6/4) moist; weak coarse subangular blocky structure; slightly hard, friable; few fine roots; few wormcasts; about 80 percent limestone fragments 3 to 6 inches in diameter; strong effervescence; moderately alkaline; abrupt smooth boundary.

R—32 inches; very pale brown (10YR 8/3) chalky limestone.

The solum is 10 to 24 inches thick. The mollic epipedon is 7 to 20 inches thick. Depth to chalky limestone ranges from 20 to 40 inches. The soil has lime throughout and is mildly alkaline or moderately alkaline.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly gravelly loam, although the range includes loam. The Bw horizon has hue of 10YR, value of 3 to 6 (2 to 4 moist), and chroma of 1 to 3. It is gravelly loam, very gravelly loam, or channery loam. Limestone or chalk fragments make up 40 to 65 percent of the volume. The C horizon has hue of 10YR, value of 6 to 8 (5 to 7 moist), and chroma of 1 to 4. It is channery loam, very channery loam, or very gravelly loam. Limestone or chalk fragments make up 35 to 80 percent of the volume.

Carr Series

The Carr series consists of deep, well drained, moderately rapidly permeable soils on flood plains. These soils formed in calcareous alluvium. The slope ranges from 0 to 1 percent.

Carr soils are similar to McCook soils and are commonly adjacent to Inavale and McCook soils. McCook soils have less sand than Carr soils and are on terraces. Inavale soils have more sand than Carr soils and are in similar positions on the landscape.

Typical pedon of Carr fine sandy loam, 2,000 feet north and 1,600 feet west of the southeast corner of sec. 2, T. 1 S., R. 7 W.

A—0 to 8 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; slightly hard, very friable; few fine roots; slight effervescence; mildly alkaline; gradual smooth boundary.

C1—8 to 42 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak granular structure; soft, very friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

2C2—42 to 60 inches; light gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; single grained; loose; strong effervescence; moderately alkaline.

The solum is 4 to 16 inches thick. Depth to lime is less than 10 inches. The soil is mildly alkaline or moderately alkaline.

The A horizon has hue of 10YR, value of 5 to 7 (3 to 5 moist), and chroma of 1 to 3. It is dominantly fine sandy loam, although the range includes loamy fine sand and sandy loam. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. The 2C horizon has hue of 10YR, value of 6 or 7 (5 or 6 moist), and chroma of 2 or 3. It is fine sand or loamy fine sand. Some pedons do not have a 2C horizon. Faint mottles are below a depth of 20 inches, and in some pedons distinct mottles are below a depth of 30 inches.

Corinth Series

The Corinth series consists of moderately deep, well drained, moderately slowly permeable soils on uplands. These soils formed in residuum of calcareous shale. The slope ranges from 3 to 7 percent.

Corinth soils are commonly adjacent to Armo, Bogue, and Harney soils. Armo and Harney soils are more than 40 inches deep to bedrock. Armo soils are on foot slopes in lower positions on the landscape than Corinth soils, and Harney soils are on side slopes in higher positions. Bogue soils are more clayey throughout and are in higher positions than Corinth soils.

Typical pedon of Corinth silty clay loam, in an area of Corinth-Harney silty clay loams, 3 to 7 percent slopes, eroded, 1,400 feet north and 200 feet east of the southwest corner of sec. 6, T. 5 S., R. 7 W.

Ap—0 to 5 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; hard, firm; many fine roots; few flat pieces of calcite; strong effervescence; mildly alkaline; abrupt smooth boundary.

A—5 to 9 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; hard, firm; many fine roots; few wormcasts; few flat pieces of calcite; strong effervescence; mildly alkaline; gradual smooth boundary.

Bw—9 to 20 inches; yellowish brown (10YR 5/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; moderate fine subangular blocky structure; very hard, firm; many fine roots; few wormcasts; few flat pieces of calcite; strong effervescence; moderately alkaline; gradual smooth boundary.

C—20 to 32 inches; yellow (10YR 7/6) silty clay loam, yellowish brown (10YR 5/6) moist; weak fine subangular blocky structure; very hard, firm; few fine roots; many soft platy fragments of chalky shale; violent effervescence; moderately alkaline; gradual smooth boundary.

Cr—32 inches; yellow (10YR 7/6) calcareous soft platy shale, yellowish brown (10YR 5/6) moist.

The solum is 15 to 30 inches thick. Depth to shale ranges from 20 to 40 inches. The soil has lime throughout and is mildly or moderately alkaline.

The A horizon has hue of 2.5Y or 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 4. It is dominantly silty clay loam, although the range includes silt loam and clay loam. The Bw horizon has hue of 2.5Y or 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 3 to 6. It is silty clay loam, clay, or silty clay. The C horizon has hue of 10YR or 2.5Y, value of 6 to 8 (4 to 6 moist), and chroma of 4 to 8. It is silty clay loam, clay, or silty clay.

Crete Series

The Crete series consists of deep, moderately well drained, slowly permeable soils on uplands. The soils formed in loess. The slope ranges from 0 to 1 percent.

Crete soils are similar to Detroit and Harney soils and are commonly adjacent to Harney soils. Detroit soils have less clay in the subsoil and are on terraces. Harney soils have a mollic epipedon less than 20 inches thick and have less clay in the subsoil. They are typically in lower positions on the landscape than Crete soils.

Typical pedon of Crete silt loam, 0 to 1 percent slopes, 1,400 feet north and 200 feet east of the southwest corner of sec. 34, T. 5 S., R. 6 W.

Ap—0 to 6 inches; dark gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; hard, friable; many fine roots; medium acid; abrupt smooth boundary.

A—6 to 12 inches; dark gray (10YR 4/1) silty clay loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; hard, friable; common fine roots; slightly acid; clear smooth boundary.

BA—12 to 16 inches; dark gray (10YR 4/1) silty clay loam, very dark brown (10YR 2/2) moist; strong fine subangular blocky structure; hard, firm; common fine roots; slightly acid; clear smooth boundary.

Bt1—16 to 26 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure parting to strong fine blocky; very hard, very firm; few fine dark brown accumulations; few fine roots; slightly acid; gradual smooth boundary.

Bt2—26 to 34 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to moderate coarse blocky; very hard, very firm; many fine dark brown accumulations; few fine roots; neutral; gradual smooth boundary.

BC—34 to 40 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate fine blocky structure; hard, firm; few fine accumulations of lime; slight effervescence; mildly alkaline; clear wavy boundary.

C—40 to 60 inches; very pale brown (10YR 7/3) silty clay loam, brown (10YR 5/3) moist; few fine faint light brownish gray (10YR 6/2) and yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable; few fine accumulations of lime; mildly alkaline.

The solum is 30 to 50 inches thick. The mollic epipedon is 20 to 36 inches thick. Depth to lime typically ranges from 25 to 40 inches; however, some pedons do not have lime.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is silt loam, although the range includes silty clay loam. It is medium acid or slightly acid. The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. It is silty clay, typically ranging from 45 to 52 percent clay. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is silty clay loam or silt loam.

Detroit Series

The Detroit series consists of deep, moderately well drained, slowly permeable soils on terraces. These soils formed in alluvium. The slope ranges from 0 to 1 percent.

Detroit soils are similar to Crete and New Cambria soils and are commonly adjacent to Hord and New Cambria soils. Crete soils have more clay in the subsoil than Detroit soils and are on uplands. Hord soils have less clay in the subsoil and are in positions on the landscape similar to those of the Detroit soils. New Cambria soils have a clayey surface layer. They are in slightly lower positions than Detroit soils.

Typical pedon of Detroit silty clay loam, 1,200 feet north and 1,600 feet east of the southwest corner of sec. 10, T. 5 S., R. 6 W.

Ap—0 to 6 inches; dark gray (10YR 4/1) silty clay loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; hard, friable; slightly acid; abrupt smooth boundary.

A—6 to 12 inches; dark gray (10YR 4/1) silty clay loam, very dark brown (10YR 2/2) moist; strong medium granular structure; hard, friable; slightly acid; gradual smooth boundary.

Bt1—12 to 24 inches; dark grayish brown (10YR 4/2) silty clay, very dark brown (10YR 2/2) moist; moderate fine blocky structure; very hard, very firm; thin clay films on faces of peds; neutral; diffuse smooth boundary.

Bt2—24 to 36 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate fine blocky structure; very hard, very firm; neutral; diffuse smooth boundary.

BC—36 to 42 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak fine blocky structure; very hard, firm; few fine lime concretions; slight effervescence; mildly alkaline; gradual smooth boundary.

Ck—42 to 60 inches; light brownish gray (10YR 6/2) silty clay loam, grayish brown (10YR 5/2) moist; few fine faint brown (10YR 5/3) mottles; weak fine subangular blocky structure; hard, firm; few threads of lime; slight effervescence; mildly alkaline.

The solum is 24 to 50 inches thick. The mollic epipedon is 20 to 40 inches thick. Depth to lime ranges from 22 to 50 inches.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly silty clay loam, although the range includes silt loam. The Bt horizon has hue of 10YR, value of 3 to 5 (2 to 4 moist), and chroma of 2 or 3. It is silty clay or silty clay loam that is 35 to 45 percent clay. The C horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4.

Geary Series

The Geary series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess. The slope ranges from 3 to 11 percent.

Geary soils are similar to Holdrege and Nuckolls soils and are commonly adjacent to Holdrege, Wakeen, and Roxbury soils. Holdrege soils have a less reddish subsoil. Nuckolls soils, unlike Geary soils, do not have an argillic horizon. Wakeen soils are 20 to 40 inches deep to bedrock and are on lower side slopes. Roxbury soils have a mollic epipedon more than 20 inches thick and are on terraces or flood plains.

Typical pedon of Geary silt loam, 3 to 7 percent slopes, 200 feet south and 100 feet west of the northeast corner of sec. 33, T. 2 S., R. 7 W.

A—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist;

weak fine granular structure; slightly hard, friable; common fine roots; some wormcasts; medium acid; clear smooth boundary.

BA—10 to 14 inches; brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure; hard, friable; common fine roots; slightly acid; gradual smooth boundary.

Bt—14 to 30 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; very hard, firm; few fine roots; slightly acid; gradual smooth boundary.

BC—30 to 40 inches; light brown (7.5YR 6/4) silty clay loam, brown (7.5YR 5/4) moist; weak coarse subangular blocky structure; very hard, friable; few fine roots; neutral; gradual smooth boundary.

C—40 to 60 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; massive; hard, friable; slight effervescence; mildly alkaline.

The solum is 30 to 60 inches thick. The mollic epipedon is 10 to 20 inches thick. Depth to lime ranges from 36 to more than 60 inches.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. It is silt loam or silty clay loam and is medium acid or slightly acid. The Bt horizon has hue of 7.5YR or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 to 6. It ranges from medium acid to mildly alkaline. The C horizon has hue of 7.5YR or 5YR, value of 5 to 7 (4 or 5 moist), and chroma of 4 to 6. It is silty clay loam or clay loam.

Gibbon Series

The Gibbon series consists of deep, somewhat poorly drained, moderately slowly permeable soils on flood plains. These soils formed in calcareous alluvium. The slope ranges from 0 to 1 percent.

Gibbon soils are commonly adjacent to Carr, McCook, and Roxbury soils. Carr soils have more sand in the subsoil, and McCook soils have less clay in the subsoil than Gibbon soils. Carr and McCook soils are nearer the stream channels. Roxbury soils have a thicker mollic epipedon than Gibbon soils and are on flood plains in upland drainageways.

Typical pedon of Gibbon silty clay loam, 1,600 feet south and 200 feet east of the northwest corner of sec. 1, T. 1 S., R. 6 W.

Ap—0 to 5 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; many fine roots; strong effervescence; mildly alkaline; abrupt smooth boundary.

A—5 to 12 inches; gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; moderate medium granular structure; slightly hard, friable; many fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

ACk—12 to 19 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; common fine faint brown (10YR 5/3) mottles; moderate fine granular structure; slightly hard, friable; common black root channels; few fine accumulations of lime and salts; violent effervescence; moderately alkaline; clear smooth boundary.

Ck—19 to 26 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; common fine faint brown (10YR 5/3) mottles; massive; slightly hard, very friable; few fine soft accumulations of lime and salts; violent effervescence; moderately alkaline; clear smooth boundary.

C1—26 to 40 inches; light brownish gray (10YR 6/2) very fine sandy loam, grayish brown (10YR 5/2) moist; few fine faint brown (10YR 5/3) mottles; massive; hard, friable; violent effervescence; moderately alkaline; clear smooth boundary.

C2—40 to 60 inches; light brownish gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) moist; few fine faint yellowish brown (10YR 5/4) mottles; massive; soft, very friable; strong effervescence; strongly alkaline.

The solum is 12 to 28 inches thick. It is mildly alkaline or moderately alkaline. The mollic epipedon is 10 to 20 inches thick.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is typically silty clay loam, although the range includes very fine sandy loam, silt loam, and clay loam. The C horizon has hue of 10YR or 2.5Y, value of 5 to 8 (4 to 6 moist), and chroma of 1 or 2. It is silt loam or silty clay loam in the upper part and very fine sandy loam, fine sandy loam, or loamy sand in the lower part.

Harney Series

The Harney series consists of deep, well drained, moderately slowly permeable soils on uplands. These soils formed in loess. The slope ranges from 0 to 7 percent.

Harney soils are similar to Crete and Holdrege soils and are commonly adjacent to Crete, Corinth, Mento, and Wakeen soils. Crete soils have more clay in the subsoil than Harney soils, and they have a mollic epipedon more than 20 inches thick. They are nearly level and are slightly higher on the landscape than Harney soils. Holdrege soils have less clay in the subsoil than Harney soils. Corinth and Wakeen soils are 20 to 40 inches deep to shale. They are in lower positions on the landscape than Harney soils. Mento soils have a more abrupt textural change between the A and B horizons than Harney soils and are in slightly lower positions on the landscape.

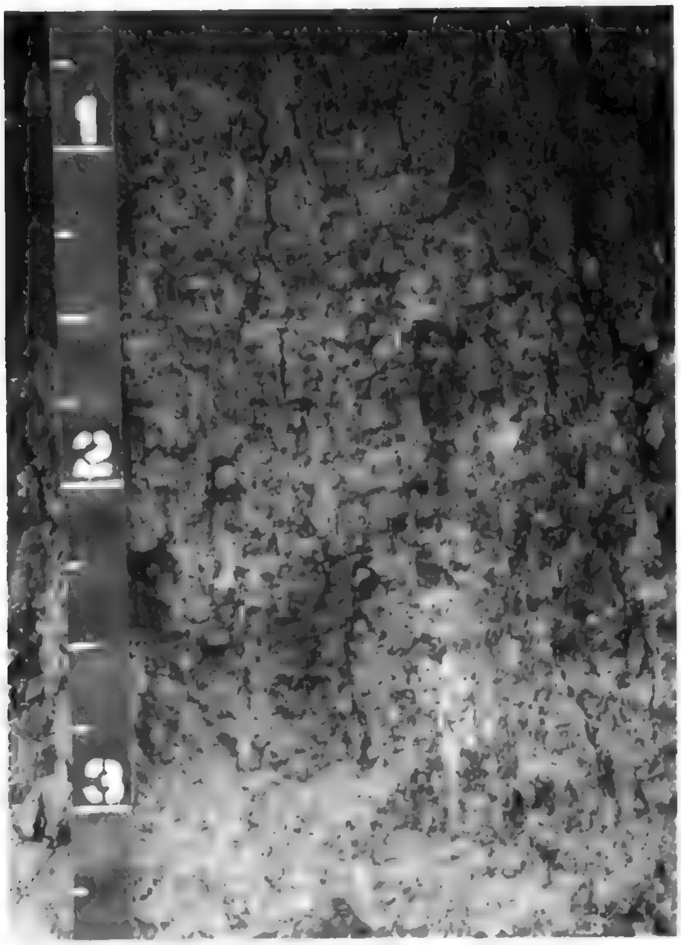


Figure 16.—Harney soils typically have lime in the lower part of the subsoil. Depth is shown in feet.

Typical pedon of Harney silt loam, 1 to 3 percent slopes (fig. 16), 200 feet south and 100 feet west of the northeast corner of sec. 29, T. 4 S., R. 7 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; many medium and fine roots; slightly acid; abrupt smooth boundary.

AB—6 to 14 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; strong fine granular structure; hard, firm; common fine and medium roots; slightly acid; gradual smooth boundary.

Bt1—14 to 24 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to moderate medium subangular; very hard, firm; few fine roots; moderately alkaline; gradual smooth boundary.

Bt2—24 to 30 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; weak coarse prismatic structure parting to strong medium subangular blocky; very hard, firm; few fine roots; mildly alkaline; gradual smooth boundary.

BCk—30 to 40 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, firm; coatings of lime on faces of peds; strong effervescence; moderately alkaline; gradual smooth boundary.

Ck—40 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable; coatings of lime on faces of peds; strong effervescence; moderately alkaline.

The solum is 26 to 60 inches thick. The mollic epipedon is 10 to 20 inches thick. Depth to lime ranges from 18 to 30 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 to 3. It is silt loam and silty clay loam and is medium acid to mildly alkaline. The Bt horizon has hue of 10YR, value of 5 or 6 (3 to 5 moist), and chroma of 2 or 3. It is silty clay loam or silty clay that is 35 to 42 percent clay. The Bt horizon ranges from slightly acid to moderately alkaline. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is silt loam or silty clay loam.

Heizer Series

The Heizer series consists of shallow, somewhat excessively drained, moderately permeable soils on uplands. These soils formed in residuum of chalky limestone. The slope ranges from 8 to 30 percent.

Heizer soils are similar to Nibson soils and are commonly adjacent to Armo, Brownell, and Bogue soils. Nibson soils, unlike Heizer soils, are less than 15 percent coarse fragments in the solum. Armo soils are more than 40 inches deep to shale and are on foot slopes. Brownell soils are 20 to 40 inches deep to limestone. They are in higher positions on the landscape than Heizer soils. Bogue soils are more clayey throughout and are in lower positions than Heizer soils.

Typical pedon of Heizer gravelly loam, in an area of Brownell-Heizer gravelly loams, 3 to 30 percent slopes, 2,600 feet east and 50 feet north of the southwest corner of sec. 27, T. 4 S., R. 8 W.

A—0 to 6 inches; dark gray (10YR 4/1) gravelly loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, friable; many fine and medium roots; numerous wormcasts; about 40 percent fine limestone fragments; strong effervescence; moderately alkaline; clear smooth boundary.

AC—6 to 10 inches; gray (10YR 5/1) channery loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; common fine and medium roots; about 45 percent limestone fragments 1 inch to 3 inches in length; violent effervescence; moderately alkaline; clear smooth boundary.

C—10 to 15 inches; light brownish gray (10YR 6/2) very channery loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, friable; few fine roots; about 80 percent limestone fragments 1 inch to 6 inches in length; violent effervescence; moderately alkaline; abrupt smooth boundary.

R—15 inches; white (10YR 8/2) chalky limestone; few vertical cracks.

The solum is 8 to 14 inches thick. The mollic epipedon is 7 to 10 inches thick. Depth to chalky limestone ranges from 10 to 20 inches. This soil has lime throughout and is mildly alkaline or moderately alkaline.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly gravelly loam, although the range includes loam. The AC horizon has hue of 10YR, value of 5 or 6 (3 to 5 moist), and chroma of 1 or 2. It is channery loam or gravelly loam. The C horizon has hue of 10YR, value of 5 to 8 (4 to 7 moist), and chroma of 2 or 3. It is channery loam, very channery loam, or very gravelly loam. Coarse limestone or chalk fragments, 1/2 inch to 6 inches in length, make up 35 to 80 percent of the volume.

Holdrege Series

The Holdrege series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess. The slope ranges from 3 to 11 percent.

Holdrege soils are similar to Geary, Harney, and Kenesaw soils and are commonly adjacent to Geary, Roxbury, and Wakeen soils. Geary soils have a redder subsoil than Holdrege soils. Harney soils have more clay in the subsoil, and Kenesaw soils have less clay in the subsoil. Roxbury soils have a mollic epipedon more than 20 inches thick. They are on flood plains in upland drainageways. Wakeen soils are 20 to 40 inches deep to shale. They are in lower positions on the landscape than Holdrege soils.

Typical pedon of Holdrege silt loam, 3 to 7 percent slopes, 400 feet west and 300 feet north of the southeast corner of sec. 34, T. 1 S., R. 10 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; many fine roots; medium acid; abrupt smooth boundary.

A—6 to 12 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; many fine roots; medium acid; clear smooth boundary.

Bt1—12 to 16 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable; shiny faces on most peds; common fine roots; neutral; clear smooth boundary.

Bt2—16 to 26 inches; very pale brown (10YR 7/3) silty clay loam, brown (10YR 5/3) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, firm; few thin discontinuous clay films and few shiny surfaces on most peds; few fine roots; neutral; clear smooth boundary.

BC—26 to 32 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; few fine roots; mildly alkaline; gradual smooth boundary.

C—32 to 60 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; weak coarse prismatic structure; soft, very friable; few soft accumulations of lime; violent effervescence; moderately alkaline.

The solum is 20 to 38 inches thick. The mollic epipedon is 8 to 20 inches thick. Depth to lime ranges from 22 to 38 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2. It is silt loam, except in some eroded areas where the Ap horizon is silty clay loam. The A horizon ranges from neutral to medium acid. The Bt horizon has hue of 10YR, value of 4 to 7 (3 to 5 moist), and chroma of 2 to 4. It is silty clay loam that is 28 to 35 percent clay. The C horizon has hue of 10YR, value of 6 or 7 (5 or 6 moist), and chroma of 2 to 4. It is mildly alkaline or moderately alkaline.

Hord Series

The Hord series consists of deep, well drained, moderately permeable soils on terraces. These soils formed in alluvium. The slope ranges from 0 to 1 percent.

Hord soils are similar to Roxbury soils and are commonly adjacent to Detroit and Roxbury soils. Roxbury soils, unlike Hord soils, have lime at or near the surface. Detroit soils have more clay in the subsoil. They are on terraces slightly lower on the landscape than Hord soils.

Typical pedon of Hord silt loam, 2,000 feet west and 200 feet south of the northeast corner of sec. 25, T. 2 S., R. 10 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable;

common medium and fine roots; slightly acid; abrupt smooth boundary.

A—6 to 16 inches; grayish brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; slightly hard, friable; common medium and fine roots; many wormcasts; slightly acid; clear smooth boundary.

Bw—16 to 30 inches; grayish brown (10YR 5/2) silt loam, very dark brownish gray (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable; common fine roots; many wormcasts; neutral; clear smooth boundary.

BC—30 to 42 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure; soft, very friable; few very fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

Ab—42 to 60 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; massive; soft, friable; strong effervescence; moderately alkaline.

The solum is 24 to 60 inches thick. The mollic epipedon is 20 to 40 inches thick. Depth to lime ranges from 20 to 48 inches. A buried soil horizon is commonly below a depth of 40 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly silt loam, although the range includes loam. The A horizon is medium acid to neutral. The Bw horizon is similar in color to the A horizon. It is silt loam or silty clay loam and is slightly acid or neutral.

Inavale Series

The Inavale series consists of deep, somewhat excessively drained, rapidly permeable soils on flood plains. These soils formed in calcareous alluvium. The slope ranges from 0 to 3 percent.

Inavale soils are commonly adjacent to Carr and McCook soils. Carr and McCook soils are less sandy than Inavale soils. They are in slightly higher positions on the landscape.

Typical pedon of Inavale loamy fine sand, 2,400 feet south and 400 feet west of the northeast corner of sec. 2, T. 1 S., R. 7 W.

Ap—0 to 9 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, very friable; common fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

AC—9 to 19 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, very friable; few fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

C—19 to 32 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 4/3) moist; single grained; loose; few very fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

Ab—32 to 36 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, very friable; few fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1—36 to 38 inches; very pale brown (10YR 7/3) very fine sandy loam, brown (10YR 5/3) moist; massive; slightly hard, very friable; strong effervescence; mildly alkaline; clear smooth boundary.

C2—38 to 60 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; single grained; loose; thin strata of finer and coarser material in lower part; slight effervescence; mildly alkaline.

The solum is 8 to 30 inches thick. The soil ranges from neutral to moderately alkaline throughout.

The A horizon has hue of 10YR, value of 4 to 7 (3 to 5 moist), and chroma of 2 or 3. It is dominantly loamy fine sand or fine sand, although the range includes fine sandy loam. The AC and C horizons have hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. They are loamy fine sand or fine sand. Thin subhorizons of fine sandy loam and very fine sandy loam are common below a depth of 30 inches. Some pedons do not have an Ab horizon.

Kenesaw Series

The Kenesaw series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess. Slope ranges from 6 to 11 percent.

Kenesaw soils are similar to Holdrege soils and are commonly adjacent to Holdrege and Geary soils. Holdrege soils have a more clayey subsoil than Kenesaw soils. Geary soils have a redder, more clayey subsoil. They are on lower side slopes.

Typical pedon of Kenesaw silt loam, 6 to 11 percent slopes, 1,400 feet west and 300 feet south of the northeast corner of sec. 7, T. 1 S., R. 6 W.

Ap—0 to 8 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

Bw—8 to 18 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable; neutral; gradual smooth boundary.

C1—18 to 34 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; weak fine subangular blocky structure; slightly hard, very friable; mildly alkaline; gradual smooth boundary.

C2—34 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, very friable; strong effervescence; mildly alkaline.

The solum is 12 to 26 inches thick. Depth to lime ranges from 10 to 36 inches. The soil is silt loam or loam throughout.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 to 3. It is slightly acid or neutral. The Bw horizon has hue of 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 or 3. It ranges from neutral to moderately alkaline. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. It is mildly alkaline or moderately alkaline.

McCook Series

The McCook series consists of deep, well drained, moderately permeable soils on terraces. These soils formed in calcareous alluvium. The slope ranges from 0 to 1 percent.

McCook soils are similar to Carr soils and commonly are adjacent to Carr and Roxbury soils. Carr soils have more sand throughout. Roxbury soils have a mollic epipedon more than 20 inches thick and more clay in the subsoil. They are on flood plains along stream channels.

Typical pedon of McCook silt loam, 1,600 feet west and 2,600 feet south of the northeast corner of sec. 1, T. 1 S., R. 7 W.

Ap—0 to 6 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, very friable; common fine roots; few wormcasts; slight effervescence; mildly alkaline; abrupt smooth boundary.

A—6 to 16 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, very friable; common fine roots; few wormcasts; slight effervescence; mildly alkaline; clear smooth boundary.

AC—16 to 22 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak fine granular; soft, very friable; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—22 to 42 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable; fine stratification in upper part; few fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

C2—42 to 60 inches; light gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) moist; massive; soft, very friable; strong effervescence; moderately alkaline.

The solum is 16 to 30 inches thick. The mollic epipedon is 10 to 20 inches thick.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly silt loam although the range includes very fine sandy loam and fine sandy loam. In most areas the surface is covered by as much as 10 inches of a light colored, recent silt loam overwash. The AC and C horizons have hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. Some pedons are coarse sand or gravelly sand below a depth of 40 inches.

Mento Series

The Mento series consists of deep, well drained, slowly permeable soils on uplands. These soils formed in loess over chalky limestone. The slope ranges from 3 to 7 percent.

Mento soils are commonly adjacent to Brownell, Harney, and Nibson soils. Brownell soils are 20 to 40 inches deep to limestone and have many coarse fragments in the subsoil. They are in lower positions on the landscape than Mento soils. Harney soils have a less abrupt textural change between the A and B horizons. They are in slightly higher positions on the landscape than Mento soils. Nibson soils are less than 20 inches deep to shale or limestone and are in lower positions.

Typical pedon of Mento silt loam, in an area of Harney-Mento silt loams, 3 to 7 percent slopes, 1,400 feet north and 2,200 feet west of the southeast corner of sec. 36, T. 3 S., R. 8 W.

A—0 to 8 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; common fine roots; neutral; abrupt smooth boundary.

Bt—8 to 14 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to strong fine blocky; very hard; very few moderately thick patchy clay films on faces of peds; few fine roots; mildly alkaline; gradual smooth boundary.

Btk—14 to 28 inches; brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; moderate medium blocky structure; very hard, very firm; few thin clay films on faces of peds; few fine roots; many soft medium lime accumulations; strong effervescence; moderately alkaline; gradual smooth boundary.

BCk—28 to 42 inches; light yellowish brown (10YR 6/4) silty clay loam, yellowish brown (10YR 5/4) moist; weak medium subangular blocky structure; hard, firm; few very fine roots; few coarse root channels filled with darker colored soil material; common soft fine lime accumulations; strong effervescence; moderately alkaline; clear smooth boundary.

2C—42 to 46 inches; very pale brown (10YR 8/3) clay loam, very pale brown (10YR 7/4) moist; medium blocky fragments; hard, friable; common chalk or limestone pebbles; violent effervescence; moderately alkaline; abrupt smooth boundary.

2R—46 inches; white (10YR 8/2) chalky limestone.

The solum is 24 to 46 inches thick. The mollic epipedon is 9 to 20 inches thick. Depth to chalk or limestone bedrock ranges from 40 to 70 inches. Depth to lime ranges from 10 to 20 inches.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. It is neutral or mildly alkaline. The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3. It is silty clay or silty clay loam that is 35 to 45 percent clay. Exchangeable sodium ranges from 5 to 15 percent. Some pedons have a silty clay loam C horizon. The 2C horizon has hue of 10YR or 2.5Y, value of 6 to 8 (5 to 7 moist), and chroma of 2 to 4. It is clay loam or gravelly clay loam.

New Cambria Series

The New Cambria series consists of deep, moderately well drained, slowly permeable soils on terraces. These soils formed in calcareous clayey and silty alluvium. The slope ranges from 0 to 1 percent.

New Cambria soils are similar to Detroit soils and are commonly adjacent to Detroit and Roxbury soils. Detroit soils have a noncalcareous, silty surface layer and are on slightly higher terraces than New Cambria soils. Roxbury soils have less clay in the subsoil and are nearer the stream channel than New Cambria soils.

Typical pedon of New Cambria silty clay, 1,200 feet south and 1,300 feet west of the northeast corner of sec. 13, T. 2 S., R. 6 W.

Ap—0 to 4 inches; gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; weak fine subangular blocky and moderate fine granular structure; very hard, firm; many fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

A—4 to 15 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; strong fine granular and moderate fine subangular blocky structure; very hard, very firm; common fine roots; slight effervescence; mildly alkaline; gradual smooth boundary.

Bw—15 to 38 inches; gray (10YR 5/1) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium angular blocky structure; extremely hard, very firm; common fine roots and pores; slight effervescence; moderately alkaline; diffuse smooth boundary.

C—38 to 60 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; few fine faint grayish brown (2.5Y 5/2) mottles below a depth of 45 inches; massive; very hard, firm; many very fine pores; few very fine roots; many films and threads of lime; strong effervescence; moderately alkaline.

The solum is 25 to 45 inches thick. The mollic epipedon is 20 to 40 inches thick. Depth to lime is less than 10 inches. The solum is silty clay, clay, or silty clay loam.

The A horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is mildly alkaline or moderately alkaline. The Bw horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6 (4 or 5 moist), and chroma of 1 to 3. It is silty clay loam or silty clay.

Nibson Series

The Nibson series consists of shallow, somewhat excessively drained, moderately permeable soils on uplands. These soils formed in residuum of interbedded chalky shale and soft limestone. The slope ranges from 5 to 25 percent.

Nibson soils are similar to Heizer soils and are commonly adjacent to Armo, Harney, Mento, and Wakeen soils. Heizer soils are more than 15 percent coarse fragments in the solum. Armo, Harney, and Mento soils are more than 40 inches deep to bedrock. Armo soils are on foot slopes. Harney and Mento soils are on ridgetops. Wakeen soils are 20 to 40 inches deep to chalky shale. They are in slightly higher positions on the landscape than Nibson soils.

Typical pedon of Nibson silt loam, 5 to 25 percent slopes, 2,000 feet south and 300 feet west of the northeast corner of sec. 2, T. 5 S., R. 6 W.

A—0 to 10 inches; very dark grayish gray (10YR 3/1) silt loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; slightly hard, friable; many fine and medium roots; few wormcasts; few limestone fragments; slight effervescence; moderately alkaline; gradual wavy boundary.

Bw—10 to 15 inches; light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; slightly hard, friable; many fine roots; many wormcasts; few limestone fragments; strong effervescence; moderately alkaline; gradual wavy boundary.

C—15 to 19 inches; white (10YR 8/2) silty clay loam, light yellowish brown (10YR 6/4) moist; medium subangular blocky structure; slightly hard, friable; many fine roots; few wormcasts; 15 percent limestone fragments; thin coatings of lime on underside of rock fragments; violent effervescence; strongly alkaline; clear wavy boundary.

Cr—19 inches; white (10YR 8/2) and very pale brown (10YR 8/3) interbedded chalky shale and soft limestone.

The solum is 10 to 15 inches thick. The mollic epipedon is 7 to 10 inches thick. Depth to chalky shale and soft limestone ranges from 10 to 20 inches. The solum is 0 to 15 percent soft limestone or chalky shale fragments.

The A horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is mildly alkaline to strongly alkaline. The Bw horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is silty clay loam or silt loam and is moderately alkaline or strongly alkaline. The C horizon has hue of 10YR or 2.5Y, value of 6 to 8 (5 to 7 moist), and chroma of 2 to 4. It is silt loam or silty clay loam and is moderately alkaline or strongly alkaline.

Nuckolls Series

The Nuckolls series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess. The slope ranges from 7 to 30 percent.

Nuckolls soils are similar to Geary soils and are commonly adjacent to Holdrege, Roxbury, and Wakeen soils. Geary and Holdrege soils, unlike Nuckolls soils, have an argillic horizon. In addition, Holdrege soils have a less reddish subsoil than Nuckolls soils, and they are in higher positions on the landscape. Roxbury soils have a mollic epipedon more than 20 inches thick and are on flood plains in upland drainageways. Wakeen soils are 20 to 40 inches deep to chalky shale. They are on lower side slopes.

Typical pedon of Nuckolls silt loam, in an area of Nuckolls-Roxbury silt loams, 0 to 30 percent slopes, 1,800 feet west and 200 feet north of the southeast corner of sec. 2, T. 1 S., R. 10 W.

A—0 to 10 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; many fine roots; neutral; clear smooth boundary.

BA—10 to 14 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, friable; common fine roots; mildly alkaline; clear smooth boundary.

Bw—14 to 34 inches; light yellowish brown (10YR 6/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; hard, friable; few fine roots; mildly alkaline; gradual smooth boundary.

C—34 to 60 inches; light brown (7.5YR 6/4) silt loam, brown (7.5YR 5/4) moist; weak coarse subangular blocky structure; slightly hard, friable; few fine roots; slight effervescence; moderately alkaline.

The solum is 20 to 40 inches thick. The mollic epipedon is 7 to 14 inches thick. Depth to lime ranges from 20 to 40 inches. The soil is silt loam and silty clay loam.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 to 3. The Bw horizon has hue of 10YR or 7.5YR, value of 5 or 6 (3 to 5 moist), and chroma of 2 to 6. The C horizon has hue of 10YR, 7.5YR, or 5YR, value of 6 (5 moist), and chroma of 4.

Roxbury Series

The Roxbury series consists of deep, well drained, moderately permeable soils on terraces and flood plains. These soils formed in calcareous alluvium. The slope ranges from 0 to 2 percent.

Roxbury soils are similar to Hord soils and are commonly adjacent to Armo, McCook, and Wakeen soils. Hord soils, unlike Roxbury soils, do not have lime in the A horizon. Armo soils have a mollic epipedon less than 20 inches thick and are on foot slopes. McCook soils have less clay in the subsoil. They are on slightly higher terraces than Roxbury soils. Wakeen soils are 20 to 40 inches deep to chalky shale and are on uplands.

Typical pedon of Roxbury silt loam, 2,500 feet west and 300 feet north of the southeast corner of sec. 9, T. 5 S., R. 9 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; common medium and fine roots; many wormcasts; strong effervescence; mildly alkaline; abrupt smooth boundary.

A—6 to 24 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, very friable; common medium and fine roots; many wormcasts; strong effervescence; mildly alkaline; gradual smooth boundary.

Bw—24 to 36 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular and moderate fine subangular blocky structure; slightly hard, friable; few fine roots; few wormcasts; many fine pores; strong effervescence; mildly alkaline; gradual smooth boundary.

C1—36 to 42 inches; light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; thin strata of darker colored material; massive; hard, friable; fine threads of lime; strong effervescence; mildly alkaline; gradual smooth boundary.

C2—42 to 60 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; hard, friable; strong effervescence; moderately alkaline.

The solum is 20 to 60 inches thick. It is silt loam or silty clay loam. The mollic epipedon is 20 to 40 inches thick. Depth to lime ranges from 0 to 15 inches. The soil is mildly alkaline or moderately alkaline.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. The Bw horizon has hue of 10YR, value of 4 to 6 (2 to 4 moist), and chroma of 1 or 2. The C horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 5 to 7 (4 or 5 moist), and chroma of 2 or 3. It is loam, silt loam, or silty clay loam. In some pedons the C horizon has thin strata of more clayey or more sandy material.

Saltine Series

The Saltine series consists of deep, poorly drained, moderately slowly permeable, saline-alkali soils on flood plains. These soils formed in alluvium. Slope ranges from 0 to 2 percent.

Saltine soils are commonly adjacent to Gibbon and Roxbury soils. Gibbon and Roxbury soils are neither saline nor sodic. They are in slightly higher positions on the landscape than Saltine soils.

Typical pedon of Saltine silty clay loam, 450 feet north and 400 feet west of the southeast corner of sec. 11, T. 4 S., R. 6 W.

A1—0 to 12 inches; gray (10YR 5/1) stratified silty clay loam, dark gray (10YR 3/1) moist; weak fine granular structure; very hard, friable; many fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

A2—12 to 30 inches; gray (10YR 5/1) stratified silty clay loam, dark grayish brown (10YR 4/2) moist; massive; very hard, firm; common fine roots; slight effervescence; strongly alkaline; clear smooth boundary.

C1—30 to 46 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; many strata 1 inch thick of darker and lighter material; weak medium subangular blocky structure; hard, firm, sticky; few fine roots; slight effervescence; moderately alkaline; diffuse boundary.

C2—46 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; few fine faint yellowish brown (10YR 5/4) mottles; strata of darker and lighter material; weak fine subangular blocky structure; very hard, very firm; very few fine roots; strong effervescence; strongly alkaline.

The solum is 16 to 36 inches thick. Depth to lime ranges from 0 to 10 inches. Above a depth of 20 inches, the soil is commonly saline, and the conductivity of the saturation extract is between 4 and 8 millimhos per centimeter. However, in some seasons, conductivity is less than 4 millimhos per centimeter.

The A horizon has hue of 10YR or 2.5Y, value of 4 to 6 (2 to 5 moist), and chroma of 1 or 2. Typically it is silty clay loam, although the range includes silt loam. The A horizon is neutral to strongly alkaline. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 (2 to 5 moist), and chroma of 1 to 3. It is silty clay loam or silt loam, although in some pedons it is either finer or coarser textured and has thin layers of contrasting sediment. It ranges from moderately alkaline to very strongly alkaline. Strata of darker and lighter material, buried soils, and dark layers of alluvium are common.

Wakeen Series

The Wakeen series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in residuum of chalky shale. Slope ranges from 3 to 20 percent.

Wakeen soils are similar to Armo soils and are commonly adjacent to Armo, Brownell, Holdrege, and Nibson soils. Armo soils, unlike Wakeen soils, are more than 40 inches deep to bedrock and are on foot slopes. Brownell soils have many limestone fragments in the solum. They are in lower positions on the landscape than Wakeen soils. Holdrege soils are more than 40 inches deep to bedrock and are on ridgetops. Nibson soils are less than 20 inches deep to chalky shale and limestone and are on lower side slopes.

Typical pedon of Wakeen silt loam, 3 to 7 percent slopes, 1,200 feet west and 300 feet north of the southeast corner of sec. 8, T. 2 S., R. 8 W.

A—0 to 10 inches; gray (10YR 5/1) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; few wormcasts; strong effervescence; mildly alkaline; gradual smooth boundary.

Bw—10 to 22 inches; light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; slightly hard, friable; few wormcasts; segregated lime in form of threads and films; violent effervescence; moderately alkaline; gradual smooth boundary.

BC—22 to 34 inches; very pale brown (10YR 7/3) silty clay loam, light yellowish brown (10YR 6/4) moist; weak coarse prismatic structure parting to weak fine subangular blocky; hard, friable; few fine roots; violent effervescence; strongly alkaline; gradual wavy boundary.

Cr—34 inches; white (10YR 8/1) chalky shale.

The solum is 20 to 40 inches thick. The mollic epipedon is 7 to 18 inches thick. Depth to chalky shale ranges from 20 to 40 inches. Some pedons have chalk fragments in the lower part of the solum. The soil is silt loam and silty clay loam.

The A horizon has hue of 10YR or 7.5YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is mildly alkaline or moderately alkaline. The Bw horizon has hue of 10YR or 7.5YR, value of 5 to 8 (3 to 6 moist), and chroma of 2 to 6. It is mildly alkaline to strongly alkaline.

Formation of the Soils

The characteristics of a soil at any given place are determined by the interaction of five factors of soil formation—climate, plants and other living organisms, parent material, relief, and time. Each of these factors affects the formation of every soil, and each modifies the effects of the other four. The relative effects of the individual factors vary from place to place.

Climate and vegetation act on the parent material and gradually change it to a natural body of soil. Relief modifies the effects of climate and vegetation, mainly through its influence on runoff and temperature. The nature of the parent material also affects the kind of soil that is formed. And time is needed to change the parent material into soil. Generally, a long time is required for the development of distinct soil horizons.

The interactions among these factors are more complex for some soils than for others. The five major factors of soil formation are discussed in relation to their effects on the soils in the survey area.

Parent Material

Parent material is the weathered rock or partly weathered material from which soils form. It affects the texture, structure, color, natural fertility, and many other properties of the soil. The soils in Jewell County developed in four kinds of parent material: alluvium, colluvium, loess, and residuum of chalky limestone or shale.

Alluvium is sediment deposited by floodwater in stream valleys. The alluvium in the valleys of the Republican River ranges from silty to sandy. In the smaller valleys, the sediment is mainly silty and of local origin. Carr, Detroit, Gibbon, Hord, Inavale, McCook, New Cambria, Roxbury, and Saltine soils formed in alluvial material.

Colluvium in Jewell County consists of loamy or silty sediment that accumulated at the base of steeper slopes as a result of gravitational action. This sediment is derived from chalky shale and limestone bedrock or from loess deposits. Armo soils formed in colluvial material.

Loess is silty, windborne material that can be carried as much as hundreds of miles from its source. Peorian loess was deposited during the Wisconsinan Stage of the Pleistocene Epoch and covers many of the uplands in Jewell County. In most places it is very pale brown, calcareous, and friable. Crete, Harney, and Holdrege soils formed in this material. Loveland loess is light brown or reddish brown and is from Illinoian time. Geary and Nuckolls soils formed in this material.

Bedrock outcrops in Jewell County consist of chalky limestone or shale of the Upper Cretaceous System. Corinth, Nibson, and Wakeen soils, which are calcareous, developed in residuum of chalky shale or chalky shale interbedded with thin layers of limestone. Bogue soils developed in noncalcareous, clayey shale which is a member of the Blue Hill Shale. Brownell and Heizer soils formed in residuum of thick chalky limestone of the Fort Hays Member (fig. 17).

Climate

Climate influences both physical and chemical weathering processes and the biological forces at work in the parent material. Soil-forming processes are most active in a climate that is warm and moist.

The climate of Jewell County is continental and is characterized by intermittent dry and moist periods. These dry and moist periods can occur within a year or in cycles of several years. During wet periods the soil slowly regains moisture lost during dry periods and can become saturated with excess moisture. The downward movement of water is a major factor in transforming parent material into a soil that has distinct horizons. For example, the accumulation of lime in the lower subsoil of the Harney soil is an indication of excess moisture built up during wet periods.

Climate contributes significantly to differences among soils over an extensive region; however, in a small region such as the survey area differences among soils are primarily the result of other factors.

Plant and Animal Life

All plants and animals are important to soil formation. Plants generally influence the amount of nutrients and of organic matter in the soil and the color of the surface layer. Animals, such as earthworms, cicadas, and burrowing animals, help keep the soil open and porous. Bacteria and fungi contribute to the decomposition of plants, thus releasing more nutrients into the soil.

Mid and tall prairie grasses have had the greatest influence on soil formation in Jewell County. Because of the prevalence of grasses, a typical soil in the county has a dark colored upper part that is high in content of

Figure 17.—Outcrop of bedrock of the Fort Hays Member. Brownell and Heizer soils formed in residuum of this chalky limestone.

organic matter. The part below that is a transitional layer that in many places is slightly finer textured and somewhat lighter in color than the layer above. The underlying parent material is generally light in color and high in content of lime.

Man greatly affects the development of soils. The use of soils by man in most places has increased erosion, increased or decreased the content of organic matter, and changed the relief through land leveling and industrial or urban development.

Relief

Relief, or lay of the land, influences the formation of soils through its effect on drainage, runoff, plant cover, and soil temperature. Although climate and plants are the most active factors in the formation of soils, relief is important because it modifies the change from parent material to soil. It contributes to the development of soils mainly by determining the movement of water on and in the soil.

On steep slopes, runoff is rapid, and erosion is severe. Much of the soil material is removed as fast as it forms. Nibson soils formed in the oldest parent materials in the county; however, the nature of the relief has restricted the development of these soils.

Time

The length of time needed for soil formation is related to the other factors of soil formation. As water moves through the soil profile, soluble matter and fine particles are gradually leached from the surface layer and deposited in the subsoil. The degree of leaching depends on the amount of time that has elapsed and the amount of water that penetrates the soil. A long time is required for the development of distinct horizons. For example, McCook soils are young soils that formed in recent alluvium and thus show very little horizon development other than a slight darkening of the surface layer. Crete soils are older and have been subject to soil-forming processes for thousands of years; therefore, the horizons are well defined.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of

regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazingland for a prescribed period.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, alluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Arabic numeral 2 precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium absorption ratio (SAR) of a saturation extract, or the ratio of Na^+ to $Ca^{++} + Mg^{++}$. The degrees of sodicity are—

	SAR
Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil (A, E, AB, or EB horizon) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every

year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. Includes all subdivisions of these horizons.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-76 at Belleville and Beloit, Kansas]

Month	Temperature					Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	In	In	In		In
January-----	36.9	15.4	26.2	66	-17	0.55	0.07	1.16	2	5.7
February----	42.7	20.7	31.7	74	-11	0.81	0.18	1.69	2	7.1
March-------	51.3	27.6	39.5	85	-1	1.68	0.24	2.53	4	4.2
April-------	66.0	40.8	53.4	90	17	2.32	1.05	3.60	5	0.7
May---------	75.6	51.7	63.7	98	29	3.86	1.78	5.94	6	---
June--------	84.9	61.7	73.3	105	41	4.09	2.20	6.25	6	---
July--------	90.9	66.8	78.9	108	49	3.04	1.08	4.55	5	---
August------	90.3	65.8	78.1	108	46	2.71	1.44	4.46	5	---
September---	80.4	55.6	68.0	102	33	3.05	1.74	4.37	5	---
October-----	69.9	44.4	57.2	92	20	1.69	0.41	2.82	4	0.4
November----	52.9	29.8	41.4	77	2	0.92	0.07	1.57	2	2.3
December----	40.6	20.0	30.3	69	-9	0.65	0.17	1.09	2	5.2
Year------	65.2	41.7	53.5	109	-17	25.37	18.14	31.05	48	25.6

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-76 at Belleville and Beloit, Kansas]

Probability	Temperature 24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 20	May 4	May 13
2 years in 10 later than--	April 15	April 29	May 8
5 years in 10 later than--	April 5	April 19	April 29
First freezing temperature in fall:			
1 year in 10 earlier than--	October 16	October 6	September 26
2 years in 10 earlier than--	October 20	October 11	September 30
5 years in 10 earlier than--	October 30	October 20	October 10

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-76 at Belleville and Beloit, Kansas]

Probability	Length of growing season if daily minimum temperature is-- Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	181	155	138
8 years in 10	190	165	147
5 years in 10	208	184	164
2 years in 10	225	203	182
1 year in 10	234	213	191

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ao	Armo loam, 1 to 3 percent slopes	11,100	1.9
Ar	Armo loam, 3 to 7 percent slopes	7,000	1.2
Ba	Bogue-Armo complex, 3 to 15 percent slopes	14,200	2.4
Bb	Bogue-Rock outcrop complex, 10 to 30 percent slopes	2,800	0.5
Bh	Brownell-Heizer gravelly loams, 3 to 30 percent slopes	22,800	3.9
Ca	Carr fine sandy loam	1,300	0.2
Ch	Corinth-Harney silty clay loams, 3 to 7 percent slopes, eroded	11,700	2.0
Cr	Crete silt loam, 0 to 1 percent slopes	8,200	1.4
De	Detroit silty clay loam	2,900	0.5
Ge	Geary silt loam, 3 to 7 percent slopes	16,900	2.9
Gf	Geary silty clay loam, 3 to 7 percent slopes, eroded	4,100	0.7
Gn	Gibbon silty clay loam	4,100	0.7
Ha	Harney silt loam, 0 to 1 percent slopes	12,900	2.2
Hb	Harney silt loam, 1 to 3 percent slopes	154,700	26.4
Hc	Harney silt loam, 3 to 7 percent slopes	39,200	6.7
Hf	Harney silty clay loam, 3 to 7 percent slopes, eroded	18,700	3.2
Hm	Harney-Mento silt loams, 3 to 7 percent slopes	19,900	3.4
Ho	Holdrege silt loam, 3 to 7 percent slopes	51,000	8.7
Hr	Holdrege silty clay loam, 3 to 7 percent slopes, eroded	3,500	0.6
Hs	Holdrege and Geary silty clay loams, 6 to 11 percent slopes, eroded	33,400	5.7
Hu	Hord silt loam	13,400	2.3
Ie	Inavale fine sand	580	0.1
In	Inavale loamy fine sand	780	0.1
Ke	Kenesaw silt loam, 6 to 11 percent slopes	1,600	0.3
Mc	McCook silt loam	2,300	0.4
Nc	New Cambria silty clay	3,000	0.5
Nd	Nibson silt loam, 5 to 25 percent slopes	4,700	0.8
Nr	Nuckolls-Roxbury silt loams, 0 to 30 percent slopes	24,600	4.2
Pt	Pits, quarries	568	0.1
Ra	Roxbury silt loam	20,200	3.5
Rb	Roxbury silt loam, channeled	18,900	3.2
Rc	Roxbury silt loam, occasionally flooded	19,300	3.3
Sa	Saltine silty clay loam	600	0.1
Wc	Wakeen silt loam, 3 to 7 percent slopes	12,900	2.2
Wd	Wakeen silt loam, 7 to 20 percent slopes	18,700	3.2
	Water	3,072	0.5
	Total	585,600	100.0

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn		Grain sorghum		Winter wheat	Alfalfa hay		Smooth bromegrass	
	N	I	N	I	N	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Ton	Ton	AUM*	AUM*
Ao------ Armo	50	---	60	---	40	3.5	---	4.0	8.0
Ar------ Armo	40	---	50	---	34	3.5	---	4.0	---
Ba------ Bogue-Armo	---	---	---	---	---	---	---	---	---
Bb------ Bogue-Rock outcrop	---	---	---	---	---	---	---	---	---
Bh------ Brownell-Heizer	---	---	---	---	---	---	---	---	---
Ca------ Carr	60	115	65	110	32	3.1	6.5	3.5	5.0
Ch------ Corinth-Harney	---	---	42	---	27	2.0	---	3.3	---
Cr------ Crete	50	125	60	110	40	3.2	5.5	---	---
De------ Detroit	55	125	66	120	42	3.5	6.0	4.5	10.0
Ge------ Geary	55	115	56	105	36	3.0	6.5	4.5	---
Gf------ Geary	50	105	54	100	32	2.8	6.0	4.0	---
Gn------ Gibbon	60	110	65	105	32	3.5	5.8	5.0	8.0
Ha------ Harney	55	140	62	120	42	3.5	7.0	4.5	9.0
Hb------ Harney	50	130	60	100	40	3.5	6.5	4.0	8.0
Hc------ Harney	45	95	55	90	36	2.5	4.0	3.5	5.0
Hf------ Harney	40	85	52	80	32	2.3	3.5	3.0	---
Hm------ Harney-Mento	---	---	48	---	32	2.0	---	2.5	---
Ho------ Holdrege	45	100	58	100	36	2.5	5.4	4.0	5.0
Hr------ Holdrege	40	95	54	95	34	2.5	5.2	3.7	---
Hs------ Holdrege and Geary	---	---	50	---	32	2.0	---	3.0	---
Hu------ Hord	60	135	70	125	44	3.0	6.5	4.0	11.0

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn		Grain sorghum		Winter wheat	Alfalfa hay		Smooth bromegrass	
	N	I	N	I	N	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Ton	Ton	AUM*	AUM*
Ie------------------------- Inavale	---	---	---	---	---	---	---	---	---
In------------------------- Inavale	25	100	40	80	24	1.8	4.0	1.9	3.0
Ke------------------------- Kenesaw	40	---	54	---	34	2.5	---	3.5	---
Mc------------------------- McCook	55	145	65	125	42	3.0	6.5	4.2	7.0
Nc------------------------- New Cambria	---	105	54	95	36	2.5	5.5	2.0	6.0
Nd------------------------- Nibson	---	---	---	---	---	---	---	---	---
Nr------------------------- Nuckolls-Roxbury	---	---	---	---	---	---	---	---	---
Pt. Pits									
Ra------------------------- Roxbury	60	145	68	130	44	4.2	8.0	4.0	9.0
Rb------------------------- Roxbury	---	---	---	---	---	---	---	---	---
Rc------------------------- Roxbury	60	125	56	110	35	3.5	6.5	5.0	11.0
Sa------------------------- Saltine	---	---	---	---	---	---	---	---	---
Wc------------------------- Wakeen	---	---	44	---	28	2.0	---	2.5	---
Wd------------------------- Wakeen	---	---	---	---	---	---	---	---	---

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Ao, Ar: Armo	Limy Upland	Favorable	4,000	Big bluestem	40
		Normal	3,000	Little bluestem	20
		Unfavorable	1,000	Sideoats grama	10
				Indiangrass	5
				Switchgrass	5
				Leadplant	5
				Western wheatgrass	5
Ba*:					
Bogue	Blue Shale	Favorable	3,000	Big bluestem	40
		Normal	2,000	Little bluestem	20
		Unfavorable	1,000	Sideoats grama	15
				Leadplant	10
				Indiangrass	5
Armo	Limy Upland	Favorable	4,000	Big bluestem	40
		Normal	3,000	Little bluestem	20
		Unfavorable	1,000	Sideoats grama	10
				Indiangrass	5
				Switchgrass	5
				Leadplant	5
				Western wheatgrass	5
Bb*:					
Bogue	Blue Shale	Favorable	3,000	Big bluestem	40
		Normal	2,000	Little bluestem	20
		Unfavorable	1,000	Sideoats grama	15
				Leadplant	10
				Indiangrass	5
Rock outcrop.					
Bh*:					
Brownell	Limy Upland	Favorable	4,000	Big bluestem	40
		Normal	3,000	Little bluestem	20
		Unfavorable	1,000	Sideoats grama	20
				Indiangrass	5
Heizer	Shallow Limy	Favorable	3,000	Little bluestem	40
		Normal	2,000	Big bluestem	25
		Unfavorable	900	Sideoats grama	10
				Switchgrass	5
				Hairy grama	5
Ca: Carr	Sandy Lowland	Favorable	5,500	Sand bluestem	35
		Normal	4,500	Switchgrass	15
		Unfavorable	3,000	Indiangrass	10
				Little bluestem	5
				Eastern gamagrass	5
				Sedge	5
Ch*:					
Corinth	Limy Upland	Favorable	4,000	Big bluestem	40
		Normal	2,500	Little bluestem	20
		Unfavorable	1,000	Sideoats grama	10
				Switchgrass	5
				Indiangrass	5
				Western wheatgrass	5
				Leadplant	5
Harney	Loamy Upland	Favorable	5,000	Big bluestem	25
		Normal	3,500	Little bluestem	20
		Unfavorable	2,000	Sideoats grama	10
				Western wheatgrass	10
				Blue grama	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Cr: Crete	Clay Upland	Favorable	4,000	Big bluestem	25
		Normal	2,800	Little bluestem	15
		Unfavorable	2,000	Switchgrass	10
				Sideoats grama	10
				Indiangrass	5
				Western wheatgrass	5
				Tall dropseed	5
				Sedge	5
				Blue grama	5
				Porcupinegrass	5
De: Detroit	Loamy Terrace	Favorable	6,000	Big bluestem	30
		Normal	4,500	Little bluestem	10
		Unfavorable	3,000	Switchgrass	10
				Western wheatgrass	10
				Sideoats grama	10
				Indiangrass	5
				Maximilian sunflower	5
Ge, Gf: Geary	Loamy Upland	Favorable	6,000	Big bluestem	35
		Normal	4,000	Little bluestem	20
		Unfavorable	3,000	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Sideoats grama	5
Gn: Gibbon	Subirrigated	Favorable	7,000	Big bluestem	25
		Normal	5,500	Little bluestem	15
		Unfavorable	3,700	Indiangrass	15
				Switchgrass	10
				Prairie cordgrass	10
				Sedge	10
				Kentucky bluegrass	5
Ha: Harney	Loamy Upland	Favorable	5,000	Big bluestem	25
		Normal	3,500	Little bluestem	20
		Unfavorable	2,000	Sideoats grama	10
				Western wheatgrass	10
				Blue grama	5
Hb, Hc, Hf: Harney	Loamy Upland	Favorable	5,000	Big bluestem	25
		Normal	3,500	Little bluestem	20
		Unfavorable	2,000	Sideoats grama	10
				Western wheatgrass	10
				Blue grama	5
Hm*:					
Harney	Loamy Upland	Favorable	5,000	Big bluestem	25
		Normal	3,500	Little bluestem	20
		Unfavorable	2,000	Sideoats grama	10
				Western wheatgrass	10
				Blue grama	5
Mento	Clay Upland	Favorable	3,500	Blue grama	35
		Normal	2,000	Western wheatgrass	20
		Unfavorable	1,000	Sideoats grama	10
				Buffalograss	10
				Big bluestem	5
				Western ragweed	5
Ho, Hr: Holdrege	Loamy Upland	Favorable	5,500	Big bluestem	35
		Normal	4,500	Little bluestem	20
		Unfavorable	3,000	Sideoats grama	10
				Indiangrass	10

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo- sition
			Lb/acre		Pct
Hs*:					
Holdrege	Loamy Upland	Favorable	5,500	Big bluestem	35
		Normal	4,500	Little bluestem	20
		Unfavorable	3,000	Sideoats grama	10
				Indiangrass	10
Geary	Loamy Upland	Favorable	6,000	Big bluestem	35
		Normal	4,000	Little bluestem	20
		Unfavorable	3,000	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Sideoats grama	5
Hu: Hord	Loamy Terrace	Favorable	6,000	Big bluestem	30
		Normal	4,500	Little bluestem	10
		Unfavorable	3,000	Switchgrass	10
				Indiangrass	5
				Sideoats grama	5
				Blue grama	5
				Tall dropseed	5
				Western wheatgrass	5
				Porcupinegrass	5
				Sedge	5
Ie: Inavale	Sandy Lowland	Favorable	4,000	Sand bluestem	45
		Normal	3,200	Porcupinegrass	15
		Unfavorable	2,500	Little bluestem	10
				Prairie sandreed	10
				Switchgrass	5
				Sedge	5
In: Inavale	Sandy Lowland	Favorable	3,800	Sand bluestem	30
		Normal	3,000	Prairie sandreed	20
		Unfavorable	2,200	Little bluestem	15
				Switchgrass	5
				Porcupinegrass	5
				Sedge	5
Ke: Kenesaw	Loamy Upland	Favorable	5,500	Big bluestem	35
		Normal	4,500	Little bluestem	20
		Unfavorable	3,000	Sideoats grama	10
				Switchgrass	10
Mc: McCook	Loamy Terrace	Favorable	6,000	Big bluestem	35
		Normal	4,000	Little bluestem	10
		Unfavorable	3,000	Switchgrass	10
				Indiangrass	10
				Western wheatgrass	10
				Sideoats grama	10
Nc: New Cambria	Clayey Terrace	Favorable	5,000	Big bluestem	30
		Normal	4,000	Little bluestem	15
		Unfavorable	2,500	Indiangrass	10
				Switchgrass	10
				Western wheatgrass	10
				Sideoats grama	5
				Tall dropseed	5
				Blue grama	5
Nd: Nibson	Limy Upland	Favorable	4,000	Big bluestem	30
		Normal	2,500	Little bluestem	20
		Unfavorable	1,500	Sideoats grama	20
				Indiangrass	5
				Blue grama	5
				Western wheatgrass	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Nr*:					
Nuckolls	Loamy Upland	Favorable	3,500	Little bluestem	20
		Normal	2,500	Big bluestem	15
		Unfavorable	1,500	Sideoats grama	15
				Blue grama	10
				Western wheatgrass	10
				Buffalograss	5
				Switchgrass	5
				Sand dropseed	5
				Sedge	5
Roxbury	Loamy Lowland	Favorable	6,500	Big bluestem	40
		Normal	5,000	Switchgrass	15
		Unfavorable	3,500	Indiangrass	10
				Western wheatgrass	10
				Little bluestem	5
Ra: Roxbury	Loamy Terrace	Favorable	5,000	Big bluestem	35
		Normal	4,000	Sideoats grama	15
		Unfavorable	3,000	Western wheatgrass	15
				Switchgrass	10
				Little bluestem	10
				Indiangrass	5
Rb, Rc: Roxbury	Loamy Lowland	Favorable	6,500	Big bluestem	40
		Normal	5,000	Switchgrass	15
		Unfavorable	3,500	Indiangrass	10
				Western wheatgrass	10
				Little bluestem	5
Sa: Saltine	Saline Subirrigated	Favorable	4,500	Inland saltgrass	30
		Normal	3,000	Switchgrass	20
		Unfavorable	2,000	Western wheatgrass	20
				Alkali sacaton	10
Wc, Wd: Wakeen	Limy Upland	Favorable	4,000	Big bluestem	35
		Normal	2,500	Little bluestem	20
		Unfavorable	1,000	Sideoats grama	15
				Switchgrass	5
				Blue grama	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ao, Ar: Armo	Fragrant sumac, Siberian peashrub, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, bur oak, Russian-olive, Rocky Mountain juniper.	Ponderosa pine, honeylocust, green ash, Siberian elm.	---	---
Ba*: Bogue	Peking cotoneaster, Amur honeysuckle, Siberian peashrub.	Eastern redcedar, hackberry, Russian-olive, green ash, Rocky Mountain juniper.	Austrian pine, honeylocust, Russian mulberry.	Siberian elm	---
Armo	Fragrant sumac, Siberian peashrub, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, bur oak, Russian-olive, Rocky Mountain juniper.	Ponderosa pine, honeylocust, green ash, Siberian elm.	---	---
Bb*: Bogue	Peking cotoneaster, Amur honeysuckle, Siberian peashrub.	Eastern redcedar, hackberry, Russian-olive, green ash, Rocky Mountain juniper.	Austrian pine, honeylocust, Russian mulberry.	Siberian elm	---
Rock outcrop.					
Bh*: Brownell.					
Heizer.					
Ca: Carr	---	Siberian peashrub, Tatarian honeysuckle.	Eastern redcedar, Russian-olive, osageorange, Washington hawthorn.	Bur oak, honeylocust, hackberry, green ash.	Eastern cottonwood.
Ch*: Corinth	Fragrant sumac, Tatarian honeysuckle, Siberian peashrub, silver buffaloberry.	Eastern redcedar, Russian-olive, Rocky Mountain juniper, bur oak.	Siberian elm, honeylocust, green ash, ponderosa pine.	---	---
Harney	Amur honeysuckle, lilac, fragrant sumac.	Russian mulberry	Eastern redcedar, bur oak, honeylocust, Russian-olive, Austrian pine, green ash, hackberry.	Siberian elm	---
Cr: Crete	Peking cotoneaster, Siberian peashrub, Amur honeysuckle.	Eastern redcedar, Rocky Mountain juniper, hackberry.	Austrian pine, honeylocust, green ash.	Siberian elm	---
De: Detroit	Amur honeysuckle, Siberian peashrub, Peking cotoneaster.	Eastern redcedar, hackberry, Rocky Mountain juniper.	Austrian pine, Russian-olive, green ash, honeylocust, Russian mulberry.	Siberian elm	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ge, Gf----------- Geary	Lilac, fragrant sumac, Amur honeysuckle.	Russian mulberry	Eastern redcedar, hackberry, bur oak, green ash, Russian-olive, Austrian pine, honeylocust.	Siberian elm------	---
Gn--------------- Gibbon	Redosier dogwood	Common chokecherry, American plum.	Eastern redcedar, hackberry.	Green ash, honeylocust, silver maple, golden willow, Austrian pine.	Eastern cottonwood.
Ha, Hb, Hc, Hf---- Harney	Amur honeysuckle, lilac, fragrant sumac.	Russian mulberry	Eastern redcedar, bur oak, honeylocust, Russian-olive, Austrian pine, green ash, hackberry.	Siberian elm------	---
Hm*:					
Harney-----------	Amur honeysuckle, lilac, fragrant sumac.	Russian mulberry	Eastern redcedar, bur oak, honeylocust, Russian-olive, Austrian pine, green ash, hackberry.	Siberian elm------	---
Mento------------	Lilac, Siberian peashrub, silver buffaloberry.	Eastern redcedar, Russian-olive, Rocky Mountain juniper, green ash, Siberian elm.	Ponderosa pine----	---	---
Ho, Hr----------- Holdrege	Lilac, Amur honeysuckle, fragrant sumac.	Russian mulberry	Eastern redcedar, Austrian pine, green ash, honeylocust, hackberry, bur oak, Russian-olive.	Siberian elm------	---
Hs*:					
Holdrege---------	Lilac, Amur honeysuckle, fragrant sumac.	Russian mulberry	Eastern redcedar, Austrian pine, green ash, honeylocust, hackberry, bur oak, Russian-olive.	Siberian elm------	---
Geary------------	Lilac, fragrant sumac, Amur honeysuckle.	Russian mulberry	Eastern redcedar, hackberry, bur oak, green ash, Russian-olive, Austrian pine, honeylocust.	Siberian elm------	---
Hu--------------- Hord	American plum-----	Lilac, Tatarian honeysuckle.	Eastern redcedar, ponderosa pine, Austrian pine, green ash, Russian mulberry, Russian-olive.	Honeylocust, hackberry.	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
Ie, In. Inavale	Lilac, American plum.	Common chokecherry	Eastern redcedar, Austrian pine, Scotch pine, Russian mulberry, green ash, honeylocust, hackberry.	Siberian elm	---
Ke. Kenesaw	Fragrant sumac, Amur honeysuckle, lilac.	Russian mulberry	Eastern redcedar, green ash, honeylocust, hackberry, Russian-olive, bur oak, Austrian pine.	Siberian elm	---
Mc. McCook	American plum, lilac.	Tatarian honeysuckle.	Eastern redcedar, ponderosa pine, hackberry, green ash, Russian-olive, Rocky Mountain juniper.	Honeylocust, Siberian elm.	Eastern cottonwood.
Nc. New Cambria	---	Siberian peashrub, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, Russian-olive, ponderosa pine, green ash, Russian mulberry.	Siberian elm, hackberry, honeylocust.	Eastern cottonwood.
Nd. Nibson					
Nr*:					
Nuckolls	Lilac, fragrant sumac, Amur honeysuckle.	Russian mulberry	Eastern redcedar, hackberry, bur oak, green ash, honeylocust, Austrian pine.	Siberian elm	---
Roxbury	---	Tatarian honeysuckle, Siberian peashrub, silver buffaloberry.	Eastern redcedar, Russian-olive, ponderosa pine, green ash, Russian mulberry.	Siberian elm, hackberry, honeylocust.	Eastern cottonwood.
Pt. Pits					
Ra. Roxbury	---	Siberian peashrub, Tatarian honeysuckle, silver buffaloberry.	Russian mulberry, ponderosa pine, green ash, Russian-olive, eastern redcedar.	Hackberry, Siberian elm, honeylocust.	Eastern cottonwood.
Rb, Rc. Roxbury	---	Tatarian honeysuckle, Siberian peashrub, silver buffaloberry.	Eastern redcedar, Russian-olive, ponderosa pine, green ash, Russian mulberry.	Siberian elm, hackberry, honeylocust.	Eastern cottonwood.
Sa. Saltine	Silver buffalo-berry, Tatarian honeysuckle, Siberian peashrub.	Eastern redcedar, Russian-olive.	Golden willow, Siberian elm.	---	Eastern cottonwood.
Wc, Wd. Wakeen	Siberian peashrub, fragrant sumac, silver buffaloberry, Tatatarian honeysuckle.	Eastern redcedar, Russian-olive, Rocky Mountain juniper, bur oak.	Honeylocust, Siberian elm, ponderosa pine, green ash.	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Ao, Ar Armo	Slight	Slight	Moderate: slope.	Slight.
Ba*:				
Bogue	Moderate: slope, percs slowly, too clayey.	Moderate: slope, too clayey, percs slowly.	Severe: slope.	Moderate: too clayey.
Armo	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Bb*:				
Bogue	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too clayey, slope.
Rock outcrop.				
Bh*:				
Brownell	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Slight.
Heizer	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Moderate: slope.
Ca Carr	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Ch*:				
Corinth	Slight	Slight	Moderate: slope, depth to rock.	Slight.
Harney	Slight	Slight	Moderate: slope.	Slight.
Cr Crete	Slight	Slight	Slight	Slight.
De Detroit	Severe: flooding.	Slight	Slight	Severe: erodes easily.
Ge, Gf Geary	Slight	Slight	Moderate: slope.	Slight.
Gn Gibbon	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Moderate: wetness.
Ha Harney	Slight	Slight	Slight	Slight.
Hb, Hc, Hf Harney	Slight	Slight	Moderate: slope.	Slight.
Hm*:				
Harney	Slight	Slight	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Hm*:				
Mento	Slight	Slight	Moderate: slope.	Slight.
Ho, Hr Holdrege	Slight	Slight	Moderate: slope.	Slight.
Hs*:				
Holdrege	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Geary	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Hu Hord	Severe: flooding.	Slight	Slight	Slight.
Ie Inavale	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
In Inavale	Severe: flooding.	Slight	Slight	Slight.
Ke Kenesaw	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Mc McCook	Severe: flooding.	Slight	Slight	Slight.
Nc New Cambria	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
Nd Nibson	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.
Nr*:				
Nuckolls	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Roxbury	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
Pt. Pits				
Ra Roxbury	Severe: flooding.	Slight	Slight	Slight.
Rb Roxbury	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
Rc Roxbury	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Sa Saltine	Severe: flooding, excess sodium, excess salt.	Severe: excess sodium, excess salt.	Severe: flooding, excess sodium, excess salt.	Moderate: flooding.
Wc Wakeen	Slight	Slight	Moderate: slope, depth to rock.	Slight.
Wd Wakeen	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hard-wood trees	Conif-erous plants	Shrubs	Wetland plants	Shallow water areas	Open-land wild-life	Wood-land wild-life	Wetland wild-life	Range-land wild-life
Ao------------------ Armo	Good	Good	Good	---	---	Fair	Poor	Very poor.	Good	---	Very poor.	Fair.
Ar------------------ Armo	Fair	Good	Good	---	---	Fair	Poor	Very poor.	Good	---	Very poor.	Fair.
Ba*:												
Bogue---------------	Poor	Fair	Poor	---	---	Poor	Very poor.	Poor	Poor	---	Very poor.	Poor.
Armo----------------	Poor	Fair	Good	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Bb*:												
Bogue---------------	Poor	Fair	Poor	---	---	Poor	Very poor.	Poor	Poor	---	Very poor.	Poor.
Rock outcrop.												
Bh*:												
Brownell------------	Poor	Fair	Fair	---	---	Poor	Very poor.	Very poor.	Fair	---	Very poor.	Poor.
Heizer--------------	Very poor.	Poor	Poor	---	---	Poor	Very poor.	Very poor.	Poor	---	Very poor.	Poor.
Ca------------------ Carr	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
Ch*:												
Corinth-------------	Fair	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Poor.
Harney--------------	Fair	Good	Fair	---	---	Poor	Poor	Poor	Fair	---	Poor	Poor.
Cr------------------ Crete	Good	Good	Good	---	---	Fair	Very poor.	Very poor.	Good	---	Very poor.	Good.
De------------------ Detroit	Good	Good	Good	---	---	Good	Good	Good	Good	---	Good	Good.
Ge, Gf-------------- Geary	Fair	Good	Good	---	---	Fair	Very poor.	Very poor.	Good	---	Very poor.	Good.
Gn------------------ Gibbon	Good	Good	Good	Good	Fair	Good	Fair	Good	Good	Good	Fair	Good.
Ha------------------ Harney	Good	Good	Fair	---	---	Fair	Poor	Fair	Good	---	Poor	Poor.
Hb------------------ Harney	Good	Good	Fair	---	---	Fair	Poor	Fair	Good	---	Poor	Poor.
Hc, Hf-------------- Harney	Fair	Good	Fair	---	---	Poor	Poor	Poor	Fair	---	Poor	Poor.
Hm*:												
Harney--------------	Fair	Good	Fair	---	---	Poor	Poor	Poor	Fair	---	Poor	Poor.
Mento---------------	Fair	Good	Fair	---	---	Fair	Poor	Poor	Fair	---	Poor	Fair.
Ho, Hr-------------- Holdrege	Fair	Good	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Hs*:												
Holdrege	Fair	Good	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Geary	Fair	Good	Good	---	---	Fair	Very poor.	Very poor.	Good	---	Very poor.	Good.
Hu: Hord	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Ie: Inavale	Very poor.	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
In: Inavale	Fair	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Good.
Ke: Kenesaw	Fair	Good	Good	---	---	Good	Very poor.	Very poor.	Fair	---	Very poor.	Good.
Mc: McCook	Good	Good	Good	Good	Fair	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Nc: New Cambria	Fair	Fair	Poor	Good	Good	Fair	Poor	Poor	Fair	Good	Poor	Poor.
Nd: Nibson	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Nr*:												
Nuckolls	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Roxbury	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Fair	Poor	Fair.
Pt. Pits												
Ra: Roxbury	Good	Good	Good	Fair	Fair	Fair	Poor	Fair	Good	Fair	Poor	Fair.
Rb: Roxbury	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Fair	Poor	Fair.
Rc: Roxbury	Good	Good	Good	Fair	Fair	Fair	Poor	Fair	Good	Fair	Poor	Fair.
Sa: Saltine	Poor	Poor	Good	Poor	Poor	Poor	Good	Good	Poor	Poor	Good	Poor.
Wc: Wakeen	Fair	Good	Fair	---	---	Poor	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Wd: Wakeen	Poor	Fair	Fair	---	---	Poor	Very poor.	Very poor.	Fair	---	Very poor.	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Ao: Armo	Slight	Slight	Slight	Slight	Severe: low strength.
Ar: Armo	Slight	Slight	Slight	Moderate: slope.	Severe: low strength.
Ba*:					
Bogue	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.
Armo	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.
Bb*:					
Bogue	Severe: cutbanks cave, slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.
Rock outcrop.					
Bh*:					
Brownell	Severe: depth to rock.	Moderate: slope, depth to rock, large stones.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope, large stones.
Heizer	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.
Ca: Carr	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Ch*:					
Corinth	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Harney	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Cr: Crete	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
De: Detroit	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.
Ge, Gf: Geary	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Gn: Gibbon	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding, frost action.
Ha, Hb: Harney	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Hc, Hf------------ Harney	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Hm*:					
Harney-----------	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell,	Severe: low strength.
Mento------------	Moderate: too clayey, depth to rock.	Moderate: shrink-swell.	Moderate: shrink-swell, depth to rock.	Moderate: shrink-swell, slope.	Severe: low strength.
Ho, Hr------------ Holdrege	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Hs*:					
Holdrege---------	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
Geary------------	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
Hu---------------- Hord	Slight-----------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
Ie, In------------ Inavale	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Ke---------------- Kenesaw	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope, frost action.
Mc---------------- McCook	Slight-----------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.
Nc---------------- New Cambria	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.
Nd---------------- Nibson	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: low strength, slope.
Nr*:					
Nuckolls---------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
Roxbury----------	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
Pt. Pits					
Ra---------------- Roxbury	Slight-----------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
Rb, Rc------------ Roxbury	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Sa: Saltine	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, flooding, frost action.
Wc: Wakeen	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Wd: Wakeen	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ao, Ar: Armo	Slight	Moderate: seepage, slope.	Slight	Slight	Fair: too clayey, thin layer.
Ba*:					
Bogue	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Armo	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: too clayey, slope, thin layer.
Bb*:					
Bogue	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
Rock outcrop.					
Bh*:					
Brownell	Severe: depth to rock.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, small stones.
Heizer	Severe: depth to rock, slope.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: area reclaim, small stones, slope.
Ca: Carr	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Fair: thin layer.
Ch*:					
Corinth	Severe: percs slowly, depth to rock.	Severe: depth to rock.	Severe: too clayey, depth to rock.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Harney	Moderate: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
Cr: Crete	Severe: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Poor: hard to pack.
De: Detroit	Severe: percs slowly.	Slight	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
Ge, Gf: Geary	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Gn: Gibbon	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Fair: wetness.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ha----------------- Harney	Moderate: percs slowly.	Moderate: seepage.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
Hb, Hc, Hf---------- Harney	Moderate: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
Hm*:					
Harney-------------	Moderate: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
Mento--------------	Severe: percs slowly.	Moderate: slope, depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Fair: too clayey, small stones, thin layer.
Ho, Hr-------------- Holdrege	Slight-----------	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.
Hs*:					
Holdrege-----------	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Geary--------------	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Hu----------------- Hord	Moderate: flooding.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
Ie, In-------------- Inavale	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: seepage, too sandy, flooding.	Severe: seepage, flooding.	Poor: too sandy, seepage.
Ke----------------- Kenesaw	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Mc----------------- McCook	Moderate: flooding.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
Nc----------------- New Cambria	Severe: percs slowly.	Slight-----------	Severe: too clayey.	Moderate: flooding.	Poor: too clayey, hard to pack.
Nd----------------- Nibson	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
Nr*:					
Nuckolls-----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Roxbury------------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Pt. Pits					
Ra----------------- Roxbury	Moderate: flooding.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Rb, Rc------------- Roxbury	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Sa----------------- Saltine	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, excess sodium.	Severe: flooding, wetness.	Poor: excess salt, excess sodium.
Wc----------------- Wakeen	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Wd----------------- Wakeen	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ao, Ar----------------- Armo	Good	Improbable: excess fines.	Probable	Poor: area reclaim.
Ba*:				
Bogue	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Armo	Good	Improbable: excess fines.	Probable	Poor: area reclaim.
Bb*:				
Bogue	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
Rock outcrop.				
Bh*:				
Brownell	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Heizer	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Ca------------------- Carr	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Ch*:				
Corinth	Poor: low strength, area reclaim, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Harney	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Cr------------------- Crete	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
De------------------- Detroit	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Ge------------------- Geary	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Gf------------------- Geary	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Gn------------------- Gibbon	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ha, Hb, Hc, Hf-------- Harney	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Hm*:				
Harney	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Hm*:				
Mento	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Ho, Hr Holdrege	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Hs*:				
Holdrege	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Geary	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
Hu Hord	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ie, In Inavale	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Ke Kenesaw	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Mc McCook	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Nc New Cambria	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Nd Nibson	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Nr*:				
Nuckolls	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Roxbury	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Pt. Pits				
Ra, Rb, Rc Roxbury	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Sa Saltine	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, excess sodium.
Wc Wakeen	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
Wd Wakeen	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
Ao: Armo	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Favorable	Favorable	Favorable.
Ar: Armo	Moderate: seepage, slope.	Moderate: thin layer, piping.	Deep to water	Slope	Favorable	Favorable.
Ba*:						
Bogue	Severe: slope.	Severe: hard to pack.	Deep to water	Droughty, slow intake, percs slowly.	Slope, depth to rock, percs slowly.	Slope, droughty, depth to rock.
Armo	Severe: slope.	Moderate: thin layer, piping.	Deep to water	Slope	Slope	Slope.
Bb*:						
Bogue	Severe: slope.	Severe: hard to pack.	Deep to water	Droughty, slow intake, percs slowly.	Slope, depth to rock, percs slowly.	Slope, droughty, depth to rock.
Rock outcrop.						
Bh*:						
Brownell	Severe: slope.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Heizer	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Ca: Carr	Severe: seepage.	Severe: piping.	Deep to water	Flooding	Soil blowing	Favorable.
Ch*:						
Corinth	Moderate: slope, depth to rock.	Moderate: thin layer, hard to pack.	Deep to water	Slope, percs slowly, depth to rock.	Depth to rock, erodes easily.	Depth to rock, erodes easily.
Harney	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Slope	Erodes easily	Erodes easily.
Cr: Crete	Moderate: seepage.	Moderate: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily	Erodes easily, percs slowly.
De: Detroit	Slight	Severe: piping.	Deep to water	Percs slowly, erodes easily.	Erodes easily	Erodes easily, percs slowly.
Ge, Gf: Geary	Moderate: seepage, slope.	Slight	Deep to water	Slope	Erodes easily	Erodes easily.
Gn: Gibbon	Severe: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, flooding.	Wetness	Favorable.
Ha, Hb: Harney	Moderate: seepage.	Moderate: hard to pack.	Deep to water	Favorable	Erodes easily	Erodes easily.
Hc, Hf: Harney	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Slope	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Hm*:						
Harney	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Slope	Erodes easily	Erodes easily.
Mento	Moderate: slope.	Moderate: thin layer.	Deep to water	Percs slowly, slope, erodes easily.	Erodes easily	Erodes easily, percs slowly.
Ho, Hr Holdrege	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Hs*:						
Holdrege	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Geary	Severe: slope.	Slight	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Hu Hord	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Favorable	Favorable.
Ie, In Inavale	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Ke Kenesaw	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Mc McCook	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Nc New Cambria	Slight	Severe: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly	Percs slowly.
Nd Nibson	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Nr*:						
Nuckolls	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Roxbury	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Flooding	Erodes easily	Erodes easily.
Pt. Pits						
Ra Roxbury	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Rb, Rc Roxbury	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Flooding	Erodes easily	Erodes easily.
Sa Saltine	Moderate: seepage.	Severe: excess sodium, excess salt.	Percs slowly, flooding, frost action.	Wetness, percs slowly, flooding.	Wetness	Excess salt, excess sodium, percs slowly.
Wc Wakeen	Moderate: seepage, depth to rock, slope.	Moderate: thin layer, piping.	Deep to water	Depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Wd----------------- Wakeen	Severe: slope.	Moderate: thin layer, piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Ao, Ar------------ Armo	0-16	Loam--------------	CL	A-6, A-4	0	95-100	90-100	90-100	70-95	25-40	7-18
	16-30	Loam, silty clay loam, clay loam.	CL	A-6, A-4, A-7	0	95-100	90-100	90-100	70-90	25-45	7-22
	30-60	Silt loam, gravelly clay loam, gravelly loam.	CL, SC, GC	A-6, A-4	0	60-85	50-85	50-60	40-55	25-35	8-18
Ba*:											
Bogue------------	0-8	Clay--------------	CH, MH	A-7	0	100	100	90-100	90-100	55-85	35-50
	8-18	Clay--------------	CH, MH	A-7	0	100	100	90-100	90-100	60-90	35-50
	18-32	Clay--------------	CH, MH	A-7	0	100	100	90-100	80-100	60-90	35-50
	32	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Armo-------------	0-10	Loam--------------	CL	A-6, A-4	0	95-100	90-100	90-100	70-95	25-40	7-18
	10-60	Loam, silty clay loam, clay loam.	CL	A-6, A-4, A-7	0	95-100	90-100	90-100	70-90	25-45	7-22
Bb*:											
Bogue------------	0-8	Clay--------------	CH, MH	A-7	0	100	100	90-100	90-100	55-85	35-50
	8-18	Clay--------------	CH, MH	A-7	0	100	100	90-100	90-100	60-90	35-50
	18-32	Clay--------------	CH, MH	A-7	0	100	100	90-100	80-100	60-90	35-50
	32	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
Bh*:											
Brownell---------	0-8	Gravelly loam----	GC, SC, SM-SC, GM-GC	A-2-4, A-2-6, A-1	0-20	50-90	40-70	30-60	20-35	20-40	5-20
	8-32	Very gravelly loam, very channery loam, gravelly loam.	GC, GP-GC, SC, SP-SC	A-2-4, A-2-6, A-1	5-50	20-80	10-50	10-45	8-35	20-40	5-20
	32	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Heizer-----------	0-6	Gravelly loam----	GC, SC, SM-SC, GM-GC	A-2-4, A-2-6, A-1	0-20	50-90	40-70	30-60	20-35	20-40	5-20
	6-15	Channery loam, gravelly loam, very channery loam.	GC, SC, GP-GC, SP-SC	A-2-4, A-2-6, A-1	5-50	20-80	10-50	10-45	8-35	20-40	5-20
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Ca--------------- Carr	0-8	Fine sandy loam	SM, SC, SM-SC	A-4, A-2	0	100	95-100	70-100	25-75	10-25	2-10
	8-42	Stratified fine sandy loam to loam.	SM, SC, ML, CL	A-4	0	100	95-100	70-100	35-65	10-25	2-10
	42-60	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM	A-2-4, A-3	0	98-100	85-100	65-95	5-30	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ch*:											
Corinth	0-9	Silty clay loam	CL, CH	A-7, A-6	0	100	100	95-100	70-90	38-60	18-35
	9-32	Silty clay, silty clay loam.	CH, CL	A-7	0	100	100	95-100	75-95	40-60	20-40
	32	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Harney	0-7	Silty clay loam	CL	A-7, A-6	0	100	100	95-100	85-100	35-45	15-22
	7-33	Silty clay, silty clay loam.	CL, CH	A-7, A-6	0	100	100	95-100	85-100	35-60	15-35
	33-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	95-100	85-100	30-40	10-20
Cr Crete	0-6	Silt loam	CL	A-4, A-6	0	100	100	100	95-100	30-40	8-15
	6-34	Silty clay, silty clay loam.	CH	A-7	0	100	100	100	95-100	50-65	25-38
	34-60	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	30-55	15-35
De Detroit	0-12	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-45	15-25
	12-36	Silty clay, silty clay loam.	CH, CL	A-7	0	100	100	95-100	90-100	45-55	20-30
	36-60	Silty clay loam, silt loam.	CL, CL-ML	A-6, A-7, A-4	0	100	100	95-100	90-100	20-45	5-25
Gc Geary	0-10	Silt loam	ML, CL	A-4, A-6	0	100	100	96-100	80-98	25-40	2-15
	10-40	Silty clay loam, clay loam.	CL	A-7, A-6	0	100	100	96-100	85-98	35-50	15-25
	40-60	Silty clay loam, clay loam, silt loam.	CL	A-6, A-7	0	100	100	96-100	85-98	30-45	11-22
Gf Geary	0-6	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	75-98	35-45	15-25
	6-30	Silty clay loam, clay loam.	CL	A-7, A-6	0	100	100	96-100	85-98	35-50	15-25
	30-60	Silty clay loam, clay loam, silt loam.	CL	A-6, A-7	0	100	100	96-100	85-98	30-45	11-22
Gn Gibbon	0-19	Silty clay loam	CL, CH	A-6, A-7	0	100	100	95-100	85-100	35-55	20-35
	19-26	Silt loam, clay loam.	CL	A-6	0	100	100	90-100	55-90	25-38	12-20
	26-60	Stratified loamy sand to silt loam.	SM, SC, CL, ML	A-4	0	100	100	70-95	35-90	<25	NP-8
Ha, Hb, Hc Harney	0-6	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
	6-40	Silty clay, silty clay loam.	CL, CH	A-7, A-6	0	100	100	95-100	85-100	35-60	15-35
	40-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	95-100	85-100	30-40	10-20
Hf Harney	0-6	Silty clay loam	CL	A-7, A-6	0	100	100	95-100	85-100	35-45	15-22
	6-30	Silty clay, silty clay loam.	CL, CH	A-7, A-6	0	100	100	95-100	85-100	35-60	15-35
	30-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	95-100	85-100	30-40	10-20
Hm*:											
Harney	0-6	Silt loam	CL	A-7, A-6	0	100	100	95-100	85-100	35-45	15-22
	6-40	Silty clay, silty clay loam.	CL, CH	A-7, A-6	0	100	100	95-100	85-100	35-60	15-35
	40-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	95-100	85-100	30-40	10-20

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
Hm*:											
Mento-----------	0-8	Silt loam--------	CL	A-4, A-6, A-7-6	0	100	100	90-100	85-100	30-45	8-20
	8-28	Silty clay loam, silty clay.	CH	A-7	0	100	95-100	90-100	85-100	50-70	25-45
	28-42	Silty clay loam, silt loam.	CL	A-6, A-7-6	0	100	95-100	90-100	85-100	30-50	11-25
	42-46	Clay loam, silty clay loam, gravelly clay loam.	CL, SC, GC	A-6, A-7-6	0	70-100	65-95	55-95	40-80	35-50	15-30
	46	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Ho--------------- Holdrege	0-12	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	20-40	2-18
	12-26	Silty clay loam	CL	A-7, A-6	0	100	100	98-100	90-100	30-50	15-35
	26-32	Silt loam, silty clay loam.	CL	A-6, A-4	0	100	100	95-100	95-100	25-40	9-17
	32-60	Silt loam--------	CL, ML	A-4, A-6	0	100	100	95-100	90-100	30-40	5-15
Hr--------------- Holdrege	0-6	Silty clay loam	CL	A-7, A-6	0	100	100	95-100	85-100	30-50	15-35
	6-22	Silty clay loam	CL	A-7, A-6	0	100	100	98-100	90-100	30-50	15-35
	22-60	Silt loam--------	CL, ML	A-4, A-6	0	100	100	95-100	90-100	30-40	5-15
Hs*:											
Holdrege--------	0-6	Silty clay loam	CL	A-7, A-6	0	100	100	95-100	85-100	30-50	15-35
	6-22	Silty clay loam	CL	A-7, A-6	0	100	100	98-100	90-100	30-50	15-35
	22-60	Silt loam--------	CL, ML	A-4, A-6	0	100	100	95-100	90-100	30-40	5-15
Geary-----------	0-6	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	75-98	35-45	15-25
	6-34	Silty clay loam, clay loam.	CL	A-7, A-6	0	100	100	96-100	85-98	35-50	15-25
	34-60	Silty clay loam, clay loam, silt loam.	CL	A-6, A-7	0	100	100	96-100	85-98	30-45	11-22
Hu--------------- Hord	0-16	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0	100	100	95-100	85-100	20-35	3-18
	16-42	Silt loam, silty clay loam, loam.	CL	A-6, A-4	0	100	100	98-100	85-100	25-40	8-23
	42-60	Silt loam, very fine sandy loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	100	85-100	25-40	6-21
Ie--------------- Inavale	0-9	Fine sand--------	SM, SP-SM, SM-SC	A-2, A-3	0	100	90-100	65-85	5-30	<25	NP-5
	9-60	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	100	70-90	5-30	<25	NP-5
In--------------- Inavale	0-9	Loamy fine sand	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	85-95	5-35	<25	NP-5
	9-32	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	90-100	65-85	5-30	<25	NP-5
	32-60	Stratified fine sand to very fine sandy loam.	SP-SM, SM, SM-SC	A-2, A-3	0	100	100	70-90	5-30	<25	NP-5

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Ke---------------- Kenesaw	0-8	Silt loam---------	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	20-35	2-12
	8-18	Loam, silt loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	85-100	18-35	2-13
	18-60	Silt loam, very fine sandy loam, loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	80-100	20-35	2-12
Mc---------------- McCook	0-16	Silt loam---------	ML, CL, CL-ML	A-4	0	100	100	95-100	60-100	20-35	2-10
	16-60	Very fine sandy loam, silt loam, loam.	ML, CL, CL-ML	A-4	0	100	100	95-100	55-100	20-30	2-10
Nc---------------- New Cambria	0-15	Silty clay--------	CH	A-7-6	0	100	100	95-100	90-100	50-75	30-45
	15-38	Silty clay, silty clay loam, clay.	CH	A-7-6	0	100	100	95-100	85-100	50-75	25-45
	38-60	Silty clay, silty clay loam, clay.	CH, CL	A-7-6	0	100	100	95-100	85-100	40-60	20-40
Nd---------------- Nibson	0-10	Silt loam---------	CL	A-4, A-6	0-15	85-100	80-95	65-95	60-90	25-40	8-20
	10-19	Silty clay loam, silt loam.	CL	A-6, A-7	0-15	85-95	80-95	60-90	55-90	30-45	10-25
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Nr*:											
Nuckolls---------	0-10	Silt loam---------	ML, CL	A-4, A-6	0	100	100	95-100	90-100	24-40	2-15
	10-34	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	95-100	85-98	28-48	10-25
	34-60	Silt loam, loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	95-100	80-95	25-40	5-20
Roxbury----------	0-24	Silt loam---------	CL	A-4, A-6	0	100	100	95-100	65-100	25-40	7-20
	24-42	Silt loam, silty clay loam.	CL	A-4, A-6, A-7-6	0	100	100	95-100	80-100	30-50	8-25
	42-60	Silt loam, silty clay loam, loam.	ML, CL	A-4, A-6, A-7-6	0	100	100	95-100	65-100	30-50	7-25
Pt. Pits											
Ra, Rb, Rc-------- Roxbury	0-24	Silt loam---------	CL	A-4, A-6	0	100	100	95-100	65-100	25-40	7-20
	24-42	Silt loam, silty clay loam.	CL	A-4, A-6, A-7-6	0	100	100	95-100	80-100	30-50	8-25
	42-60	Silt loam, silty clay loam, loam.	ML, CL	A-4, A-6, A-7-6	0	100	100	95-100	65-100	30-50	7-25
Sa---------------- Saltine	0-12	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	70-95	35-50	15-30
	12-30	Silt loam, silty clay loam, loam.	CL	A-4, A-6, A-7	0	100	100	85-100	60-95	25-50	7-25
	30-46	Silty clay loam, silt loam, silty clay.	CL, CH	A-4, A-6, A-7	0	100	100	95-100	70-95	25-55	7-35
	46-60	Silty clay loam, silt loam, sandy clay loam.	CL	A-4, A-6, A-7	0	100	100	95-100	70-95	25-50	7-25
Wc, Wd------------ Wakeen	0-10	Silt loam---------	CL	A-4, A-6	0	100	100	95-100	75-95	25-40	7-20
	10-34	Silty clay loam, silt loam.	CL, ML	A-6, A-7-6	0	100	100	90-100	75-95	30-50	10-25
	34	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	Mmhos/cm					Pct
Ao, Ar----------- Armo	0-16	18-27	1.25-1.40	0.6-2.0	0.21-0.24	6.6-8.4	<2	Low--------	0.28	5	4L	1-3
	16-30	18-35	1.30-1.40	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.28			
	30-60	18-30	1.30-1.50	0.6-2.0	0.15-0.21	7.9-8.4	<2	Low--------	0.28			
Ba*: Bogue-----------	0-8	50-75	1.10-1.30	<0.06	0.11-0.14	6.6-8.4	<2	High------	0.28	3	4	---
	8-18	60-80	1.30-1.45	<0.06	0.09-0.11	6.6-8.4	<2	High------	0.28			
	18-32	60-80	1.30-1.45	<0.06	0.09-0.11	4.5-6.0	<2	High------	0.28			
	32	---	---	---	---	---	---	----------	----			
Armo------------	0-10	18-27	1.25-1.40	0.6-2.0	0.21-0.24	6.6-8.4	<2	Low--------	0.28	5	4L	1-3
	10-60	18-35	1.30-1.40	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.28			
Bb*: Bogue-----------	0-8	50-75	1.10-1.30	<0.06	0.11-0.14	6.6-8.4	<2	High------	0.28	3	4	---
	8-18	60-80	1.30-1.45	<0.06	0.09-0.11	6.6-8.4	<2	High------	0.28			
	18-32	60-80	1.30-1.45	<0.06	0.09-0.11	4.5-6.0	<2	High------	0.28			
	32	---	---	---	---	---	---	----------	----			
Rock outcrop.												
Bh*: Brownell--------	0-8	15-27	1.30-1.45	0.6-2.0	0.10-0.16	7.4-8.4	<2	Low--------	0.20	3	4L	---
	8-32	15-27	1.35-1.50	0.6-2.0	0.06-0.13	7.4-8.4	<2	Low--------	0.20			
	32	---	---	---	---	---	---	----------	----			
Heizer----------	0-6	15-27	1.30-1.45	0.6-2.0	0.10-0.16	7.4-8.4	<2	Low--------	0.24	2	8	---
	6-15	15-27	1.35-1.50	0.6-2.0	0.06-0.13	7.4-8.4	<2	Low--------	0.24			
	15	---	---	---	---	---	---	----------	----			
Ca--------------- Carr	0-8	5-15	1.50-1.75	2.0-6.0	0.14-0.20	7.4-8.4	<2	Low--------	0.24	5	3	<1
	8-42	5-15	1.50-1.75	2.0-6.0	0.13-0.18	7.4-8.4	<2	Low--------	0.24			
	42-60	2-8	1.20-1.60	6.0-20	0.06-0.09	7.4-8.4	<2	Low--------	0.15			
Ch*: Corinth---------	0-9	27-39	1.35-1.50	0.2-0.6	0.19-0.23	7.4-8.4	<2	Moderate	0.37	4	4L	.5-1
	9-32	35-45	1.45-1.50	0.2-0.6	0.11-0.18	7.4-8.4	<2	High------	0.37			
	32	---	---	---	---	---	---	----------	----			
Harney----------	0-7	28-35	1.30-1.40	0.6-2.0	0.21-0.23	5.6-7.8	<2	Moderate	0.32	5	7	1-2
	7-33	35-42	1.35-1.50	0.2-0.6	0.12-0.19	6.1-8.4	<2	Moderate	0.43			
	33-60	24-35	1.20-1.35	0.6-2.0	0.18-0.22	7.9-8.4	<2	Low--------	0.43			
Cr--------------- Crete	0-6	20-27	1.20-1.40	0.6-2.0	0.22-0.24	5.6-6.0	<2	Moderate	0.37	4	6	2-4
	6-34	42-52	1.10-1.30	0.06-0.6	0.12-0.20	6.1-7.3	<2	High------	0.37			
	34-60	25-40	1.20-1.40	0.2-2.0	0.18-0.22	7.4-8.4	<2	High------	0.37			
De--------------- Detroit	0-12	28-35	1.25-1.40	0.2-0.6	0.21-0.23	6.1-7.3	<2	Moderate	0.37	5	7	2-4
	12-36	35-45	1.35-1.50	0.06-0.2	0.12-0.15	6.6-7.8	<2	High------	0.37			
	36-60	18-35	1.30-1.50	0.2-0.6	0.18-0.20	6.6-7.8	<2	Moderate	0.37			
Ge--------------- Geary	0-10	15-27	1.30-1.40	0.6-2.0	0.22-0.24	5.6-6.5	<2	Low--------	0.32	5	6	1-4
	10-40	27-35	1.35-1.50	0.6-2.0	0.17-0.20	5.6-7.8	<2	Moderate	0.43			
	40-60	20-32	1.30-1.40	0.6-2.0	0.15-0.19	6.1-8.4	<2	Moderate	0.43			
Gf--------------- Geary	0-6	27-35	1.30-1.40	0.2-0.6	0.18-0.23	5.6-6.5	<2	Moderate	0.32	5	7	1-4
	6-30	27-35	1.35-1.50	0.6-2.0	0.17-0.20	5.6-7.8	<2	Moderate	0.43			
	30-60	20-32	1.30-1.40	0.6-2.0	0.15-0.19	6.1-8.4	<2	Moderate	0.43			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	Mmhos/cm					Pct
Gn----------------- Gibbon	0-19	27-35	1.25-1.35	0.2-0.6	0.21-0.23	7.4-8.4	<2	Moderate	0.32	5	4L	2-4
	19-26	20-27	1.30-1.50	0.6-2.0	0.18-0.22	7.9-8.4	<2	Moderate	0.32			
	26-60	15-25	1.50-1.70	0.6-6.0	0.16-0.20	7.9-9.0	<2	Low--------	0.32			
Ha, Hb, Hc-------- Harney	0-6	22-27	1.30-1.40	0.6-2.0	0.22-0.24	5.6-7.8	<2	Low--------	0.32	5	6	2-4
	6-40	35-42	1.35-1.50	0.2-0.6	0.12-0.19	6.1-8.4	<2	Moderate	0.43			
	40-60	24-35	1.20-1.35	0.6-2.0	0.18-0.22	7.9-8.4	<2	Low--------	0.43			
Hf----------------- Harney	0-6	28-35	1.30-1.40	0.6-2.0	0.21-0.23	5.6-7.8	<2	Moderate	0.32	5	7	1-2
	6-30	35-42	1.35-1.50	0.2-0.6	0.12-0.19	6.1-8.4	<2	Moderate	0.43			
	30-60	24-35	1.20-1.35	0.6-2.0	0.18-0.22	7.9-8.4	<2	Low--------	0.43			
Hm*:												
Harney-----------	0-6	22-27	1.30-1.40	0.6-2.0	0.21-0.23	5.6-7.8	<2	Moderate	0.32	5	7	2-4
	6-40	35-42	1.35-1.50	0.2-0.6	0.12-0.19	6.1-8.4	<2	Moderate	0.43			
	40-60	24-35	1.20-1.35	0.6-2.0	0.18-0.22	7.9-8.4	<2	Low--------	0.43			
Mento------------	0-8	22-27	1.30-1.40	0.2-0.6	0.21-0.23	6.6-7.8	<2	Moderate	0.37	4	6	1-3
	8-28	35-45	1.35-1.45	0.06-0.2	0.12-0.18	7.4-8.4	<2	High-------	0.37			
	28-42	21-35	1.30-1.40	0.2-0.6	0.18-0.20	7.9-8.4	<4	Moderate	0.37			
	42-46	28-35	1.35-1.45	0.2-0.6	0.10-0.18	7.9-8.4	2-8	Moderate	0.37			
	46	---	---	---	---	---	---	-----------	----			
Ho----------------- Holdrege	0-12	15-25	1.40-1.60	0.6-2.0	0.22-0.24	5.6-7.3	<2	Moderate	0.32	5	6	1-3
	12-26	28-35	1.20-1.40	0.6-2.0	0.18-0.20	6.6-7.8	<2	Moderate	0.43			
	26-32	18-30	1.30-1.50	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.43			
	32-60	15-20	1.40-1.60	0.6-2.0	0.20-0.22	7.4-8.4	<2	Moderate	0.43			
Hr----------------- Holdrege	0-6	28-35	1.40-1.60	0.6-2.0	0.21-0.23	5.6-7.3	<2	Moderate	0.32	5	6	1-3
	6-22	28-35	1.20-1.40	0.6-2.0	0.18-0.20	6.6-7.8	<2	Moderate	0.43			
	22-30	18-30	1.30-1.50	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.43			
	30-60	15-20	1.40-1.60	0.6-2.0	0.20-0.22	7.4-8.4	<2	Moderate	0.43			
Hs*:												
Holdrege---------	0-6	28-35	1.40-1.60	0.6-2.0	0.21-0.23	5.6-7.3	<2	Moderate	0.32	5	6	1-3
	6-22	28-35	1.20-1.40	0.6-2.0	0.18-0.20	6.6-7.8	<2	Moderate	0.43			
	22-60	15-20	1.40-1.60	0.6-2.0	0.20-0.22	7.4-8.4	<2	Moderate	0.43			
Geary------------	0-6	27-35	1.30-1.40	0.2-0.6	0.18-0.23	5.6-6.5	<2	Moderate	0.32	5	6	1-4
	6-34	27-35	1.35-1.50	0.6-2.0	0.17-0.20	5.6-7.8	<2	Moderate	0.43			
	34-60	20-32	1.30-1.40	0.6-2.0	0.15-0.19	6.1-8.4	<2	Moderate	0.43			
Hu----------------- Hord	0-16	17-27	1.30-1.40	0.6-2.0	0.20-0.24	6.1-7.3	<2	Low--------	0.32	5	6	2-4
	16-42	20-35	1.35-1.45	0.6-2.0	0.17-0.22	6.6-7.8	<2	Low--------	0.32			
	42-60	18-30	1.30-1.50	0.6-2.0	0.17-0.22	6.6-8.4	<2	Low--------	0.43			
Ie----------------- Inavale	0-9	1-5	1.50-1.60	6.0-20	0.07-0.09	6.6-7.8	<2	Low--------	0.17	5	1	.5-1
	9-60	3-10	1.50-1.60	6.0-20	0.05-0.10	6.6-8.4	<2	Low--------	0.17			
In----------------- Inavale	0-9	7-18	1.50-1.60	6.0-20	0.10-0.12	6.6-7.8	<2	Low--------	0.17	5	2	.5-1
	9-32	3-10	1.50-1.60	6.0-20	0.06-0.11	6.6-8.4	<2	Low--------	0.17			
	32-60	3-10	1.50-1.60	6.0-20	0.05-0.10	6.6-8.4	<2	Low--------	0.17			
Ke----------------- Kenesaw	0-8	12-20	1.20-1.40	0.6-2.0	0.20-0.24	6.1-7.3	<2	Low--------	0.32	5	6	1-3
	8-18	10-18	1.20-1.30	0.6-2.0	0.17-0.22	6.6-8.4	<2	Low--------	0.43			
	18-60	10-18	1.30-1.40	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low--------	0.43			
Mc----------------- McCook	0-16	15-20	1.20-1.40	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low--------	0.32	5	4L	2-4
	16-60	10-18	1.30-1.45	0.6-2.0	0.17-0.20	7.4-8.4	<2	Low--------	0.43			
Nc----------------- New Cambria	0-15	40-60	1.30-1.40	0.06-0.2	0.12-0.14	6.6-8.4	<2	High-------	0.28	5	4	2-4
	15-38	38-60	1.35-1.45	0.06-0.2	0.13-0.18	7.9-8.4	<2	High-------	0.28			
	38-60	30-50	1.35-1.45	0.06-0.6	0.12-0.16	7.9-8.4	<2	High-------	0.28			
Nd----------------- Nibson	0-10	15-27	1.25-1.35	0.6-2.0	0.20-0.24	7.4-9.0	<2	Low--------	0.32	2	4L	---
	10-19	18-35	1.30-1.40	0.6-2.0	0.18-0.22	7.9-9.0	<2	Moderate	0.32			
	19	---	---	---	---	---	---	-----------	----			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm^3	In/hr	In/in	pH	Mmhos/cm					Pct
Nr*:												
Nuckolls--------	0-10	20-30	1.10-1.30	0.6-2.0	0.22-0.24	6.6-7.8	<2	Low--------	0.32	5	6	2-3
	10-34	22-32	1.20-1.30	0.6-2.0	0.18-0.20	6.6-7.8	<2	Moderate	0.43			
	34-60	20-32	1.20-1.30	0.6-2.0	0.18-0.20	7.4-8.4	<2	Moderate	0.43			
Roxbury---------	0-24	18-27	1.30-1.45	0.6-2.0	0.22-0.24	6.6-8.4	<2	Low--------	0.32	5	4L	2-4
	24-42	18-35	1.35-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.43			
	42-60	18-35	1.35-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.43			
Pt. Pits												
Ra---------------- Roxbury	0-24	18-27	1.30-1.45	0.6-2.0	0.22-0.24	7.4-8.4	<2	Low--------	0.32	5	4L	2-4
	24-42	18-35	1.35-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.43			
	42-60	18-35	1.35-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.43			
Rb, Rc----------- Roxbury	0-24	18-27	1.30-1.45	0.6-2.0	0.22-0.24	6.6-8.4	<2	Low--------	0.32	5	4L	2-4
	24-42	18-35	1.35-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.43			
	42-60	18-35	1.35-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.43			
Sa---------------- Saltine	0-12	27-35	1.20-1.30	0.2-0.6	0.17-0.23	7.4-9.0	>4	High-------	0.32	5	4L	.5-2
	12-30	20-40	1.20-1.30	0.6-2.0	0.17-0.22	>8.4	>4	Moderate	0.32			
	30-46	20-45	1.30-1.40	0.06-0.6	0.10-0.22	>7.3	<2	High-------	0.32			
	46-60	20-40	1.40-1.50	0.2-2.0	0.10-0.22	>7.3	<2	Moderate	0.32			
Wc, Wd----------- Wakeen	0-10	18-27	1.30-1.45	0.6-2.0	0.22-0.24	7.4-8.4	<2	Low--------	0.32	4	4L	1-3
	10-34	18-35	1.35-1.50	0.6-2.0	0.18-0.22	7.4-9.0	<2	Moderate	0.43			
	34	---	---	---	---	---	---	-----------	----			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," and "apparent" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Ao, Ar------------- Armo	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low-------	Low.
Ba*:												
Bogue--------------	D	None---------	---	---	>6.0	---	---	20-40	Soft	Low-------	High------	Moderate.
Armo---------------	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low-------	Low.
Bb*:												
Bogue--------------	D	None---------	---	---	>6.0	---	---	20-40	Soft	Low-------	High------	Moderate.
Rock outcrop.												
Bh*:												
Brownell-----------	B	None---------	---	---	>6.0	---	---	20-40	Hard	Low-------	Low-------	Low.
Heizer-------------	D	None---------	---	---	>6.0	---	---	10-20	Hard	Moderate	Low-------	Low.
Ca----------------- Carr	B	Occasional	Very brief	Mar-Sep	>6.0	---	---	>60	---	Low-------	Low-------	Low.
Ch*:												
Corinth------------	C	None---------	---	---	>6.0	---	---	20-40	Soft	Low-------	High------	Low.
Harney-------------	C	None---------	---	---	>6.0	---	---	>60	---	Low-------	High------	Low.
Cr----------------- Crete	D	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
De----------------- Detroit	C	Rare---------	---	---	>6.0	---	---	>60	---	Low-------	High------	Low.
Ge, Gf------------- Geary	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low-------	Low.
Gn----------------- Gibbon	B	Occasional	Very brief	Mar-Jul	1.5-3.0	Apparent	Nov-Jun	>60	---	High------	High------	Low.
Ha, Hb, Hc, Hf----- Harney	C	None---------	---	---	>6.0	---	---	>60	---	Low-------	High------	Low.
Hm*:												
Harney-------------	C	None---------	---	---	>6.0	---	---	>60	---	Low-------	High------	Low.
Mento--------------	C	None---------	---	---	>6.0	---	---	40-70	Hard	Low-------	High------	Low.
Ho, Hr------------- Holdrege	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low-------	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
Hs*:												
Holdrege	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Geary	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Hu Hord	B	Rare	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Ie Inavale	A	Frequent	Very brief	Jan-Jul	>6.0	---	---	>60	---	Low	Moderate	Low.
In Inavale	A	Occasional	Very brief	Jan-Jul	>6.0	---	---	>60	---	Low	Moderate	Low.
Ke Kenesaw	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Mc McCook	B	Rare	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Nc New Cambria	C	Rare	---	---	>6.0	---	---	>60	---	Low	High	Low.
Nd Nibson	D	None	---	---	>6.0	---	---	10-20	Soft	Moderate	Low	Low.
Nr*:												
Nuckolls	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Roxbury	B	Frequent	Very brief	Apr-Sep	>6.0	---	---	>60	---	Moderate	Low	Low.
Pt. Pits												
Ra Roxbury	B	Rare	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Rb Roxbury	B	Frequent	Very brief	Apr-Sep	>6.0	---	---	>60	---	Moderate	Low	Low.
Rc Roxbury	B	Occasional	Very brief	Apr-Sep	>6.0	---	---	>60	---	Moderate	Low	Low.
Sa Saltine	C	Frequent	Brief	Apr-Jul	2.0-3.0	Apparent	Nov-Jul	>60	---	High	High	High.
Wc, Wd Wakeen	B	None	---	---	>6.0	---	---	20-40	Soft	Low	Moderate	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--ENGINEERING TEST DATA

[NP means nonplastic]

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution							Liquid limit	Plasticity index	Moisture density	
			Percentage passing sieve				Percentage smaller than--						
	AASHTO	Unified	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			Maximum density	Optimum moisture
										Pct		Lb/ft3	Pct
Carr fine sandy loam: (S79KS-089-003)													
Ap----- 0 to 8	A-2-4	SM-SC	100	100	89	25	11	4	3	19	5	120	9
C1----- 8 to 42	A-4	SM	100	100	93	43	11	4	3	18	3	115	10
2C2---- 42 to 60	A-3	SP-SM	100	100	84	7	2	1	1	--	NP	107	14
Inavale loamy fine sand: (S79KS-089-001)													
A------ 0 to 12	A-2-4	SM	100	100	96	35	8	2	1	21	2	114	9
C------ 22 to 60	A-2-4	SM	100	100	88	19	2	2	1	--	NP	112	12
McCook silt loam: (S79KS-089-002)													
A------ 0 to 10	A-4	CL-ML	100	100	98	75	27	10	4	27	7	114	14
C------ 22 to 42	A-4	CL-ML	100	100	98	87	22	5	2	27	6	103	15

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Armo	Fine-loamy, mixed, mesic Entic Haplustolls
Bogue	Very-fine, montmorillonitic, mesic Udorthentic Pellusterts
Brownell	Loamy-skeletal, carbonatic, mesic Entic Haplustolls
Carr	Coarse-loamy, mixed (calcareous), mesic Typic Udifluvents
Corinth	Fine, mixed, mesic Typic Ustochrepts
Crete	Fine, montmorillonitic, mesic Pachic Argiustolls
Detroit	Fine, montmorillonitic, mesic Pachic Argiustolls
Geary	Fine-silty, mixed, mesic Udic Argiustolls
Gibbon	Fine-silty, mixed (calcareous), mesic Fluvaquentic Haplaquolls
Harney	Fine, montmorillonitic, mesic Typic Argiustolls
Heizer	Loamy-skeletal, carbonatic, mesic Lithic Haplustolls
Holdrege	Fine-silty, mixed, mesic Typic Argiustolls
Hord	Fine-silty, mixed, mesic Cumulic Haplustolls
Inavale	Sandy, mixed, mesic Typic Ustifluvents
Kenesaw	Coarse-silty, mixed, mesic Typic Haplustolls
McCook	Coarse-silty, mixed, mesic Fluventic Haplustolls
Mento	Fine, montmorillonitic, mesic Typic Argiustolls
New Cambria	Fine, montmorillonitic, mesic Cumulic Haplustolls
Nibson	Loamy, carbonatic, mesic, shallow Entic Haplustolls
Nuckolls	Fine-silty, mixed, mesic Typic Haplustolls
Roxbury	Fine-silty, mixed, mesic Cumulic Haplustolls
Saltine	Fine-silty, mixed, mesic Typic Halaquepts
Wakeen	Fine-silty, carbonatic, mesic Entic Haplustolls

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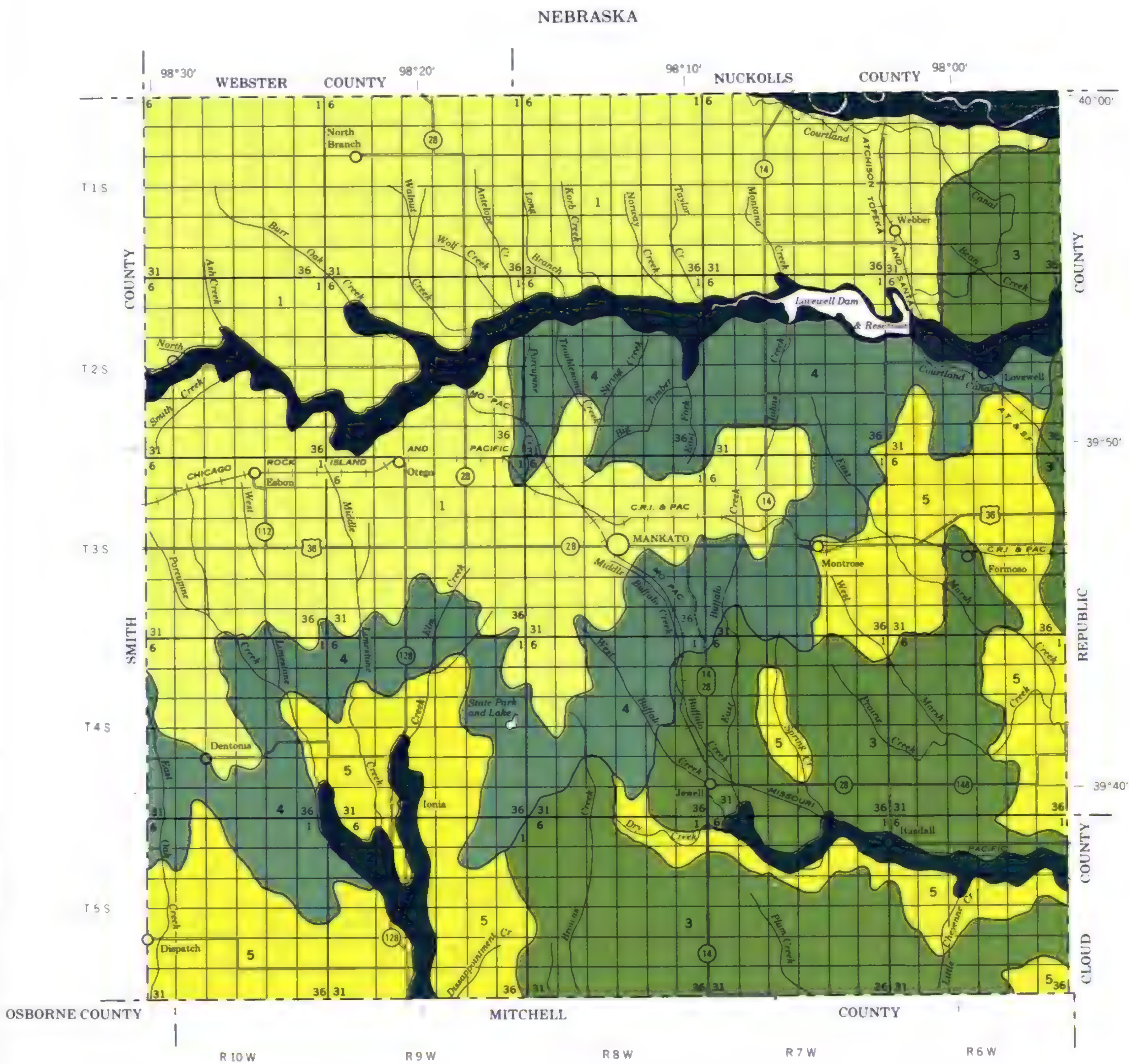
NRCS Accessibility Statement



SOIL ASSOCIATIONS

1	HARNEY-HOLDREGE-GEARY association: Deep, nearly level to strongly sloping, well drained soils that have a silty subsoil; on uplands
2	ROXBURY-HORD-NEW CAMBRIA association: Deep, nearly level, well drained and moderately well drained soils that have a silty or clayey subsoil; on terraces and flood plains
3	HARNEY-CRETE association: Deep, nearly level to moderately sloping, well drained and moderately well drained soils that have a silty or clayey subsoil; on uplands
4	BROWNELL-WAKEEN-BOGUE association: Moderately deep, moderately sloping to moderately steep, well drained and moderately well drained soils that have a loamy, silty, or clayey subsoil; on uplands
5	HARNEY-ROXBURY-CORINTH association: Deep and moderately deep, nearly level to moderately sloping, well drained soils that have a silty subsoil; on uplands and flood plains

Compiled 1983

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
KANSAS AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

JEWELL COUNTY KANSAS

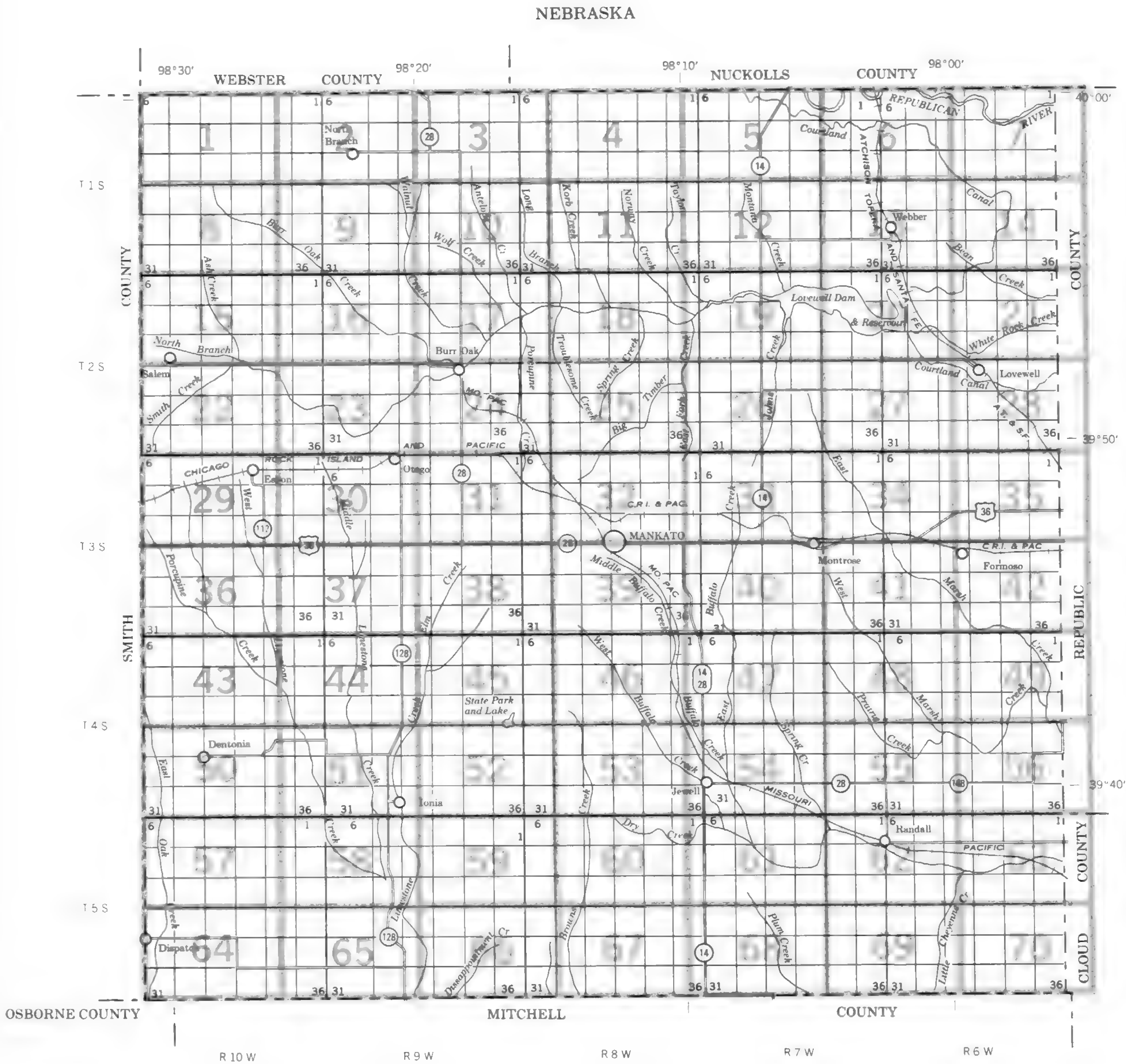
Scale 1:253,440

1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



INDEX TO MAP SHEETS

JEWELL COUNTY
KANSAS

Scale 1:253,440

1 0 1 2 3 4 Miles

4 Miles = 1"

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

SYMBOL	NAME
Ao	Armo loam, 1 to 3 percent slopes
Ar	Armo loam, 3 to 7 percent slopes
Ba	Bogue-Armo complex, 3 to 15 percent slopes
Bb	Bogue-Rock outcrop complex, 10 to 30 percent slopes
Bh	Brownell-Heizer gravelly loams, 3 to 30 percent slopes
Ca	Carr fine sandy loam
Ch	Corinth-Harney silty clay loams, 3 to 7 percent slopes, eroded
Cr	Crete silt loam, 0 to 1 percent slopes
De	Detroit silty clay loam
Ge	Geary silt loam, 3 to 7 percent slopes
Gf	Geary silty clay loam, 3 to 7 percent slopes, eroded
Gn	Gibbon silty clay loam
Ha	Harney silt loam, 0 to 1 percent slopes
Hb	Harney silt loam, 1 to 3 percent slopes
Hc	Harney silt loam, 3 to 7 percent slopes
Hf	Harney silty clay loam, 3 to 7 percent slopes, eroded
Hm	Harney-Mento silt loams, 3 to 7 percent slopes
Ho	Holdrege silt loam, 3 to 7 percent slopes
Hr	Holdrege silty clay loam, 3 to 7 percent slopes, eroded
Hs	Holdrege and Geary silty clay loams, 6 to 11 percent slopes, eroded
Hu	Hord silt loam
Ie	Inavale fine sand
In	Inavale loamy fine sand
Ke	Kenesaw silt loam, 6 to 11 percent slopes
Mc	McCook silt loam
Nc	New Cambria silty clay
Nd	Nibson silt loam, 5 to 25 percent slopes
Nr	Nuckolls-Roxbury silt loams, 0 to 30 percent slopes
Pt	Pit, quarries
Ra	Roxbury silt loam
Rb	Roxbury silt loam, channeled
Rc	Roxbury silt loam, occasionally flooded
Sa	Saltine silty clay loam
Wc	Wakeen silt loam, 3 to 7 percent slopes
Wd	Wakeen silt loam, 7 to 20 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

National, state or province
County or parish
Minor civil division
Reservation (national forest or park, state forest or park, and large airport)
Land grant
Limit of soil survey (label)
Field sheet matchline & neatline

AD HOC BOUNDARY (label)

Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

Divided (median shown if scale permits)
Other roads
Trail

ROAD EMBLEM & DESIGNATIONS

Interstate
Federal
State
County, farm or ranch

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

Without road
With road
With railroad

DAMS

Large (to scale)
Medium or small

PITS

Gravel pit
Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

Farmstead, house (omit in urban areas)
Church
School
Indian mound (label)
Located object (label)
Tank (label)
Wells, oil or gas
Windmill
Kitchen midden

WATER FEATURES

DRAINAGE

Perennial, double line
Perennial, single line
Intermittent
Drainage end
Canals or ditches
Double-line (label)
Drainage and/or irrigation
Siphon

LAKES, PONDS AND RESERVOIRS

Perennial
Intermittent

MISCELLANEOUS WATER FEATURES

Marsh or swamp
Spring
Well, artesian
Well, irrigation
Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS

ESCARPMENTS

Bedrock (points down slope)
Other than bedrock (points down slope)

SHORT STEEP SLOPE

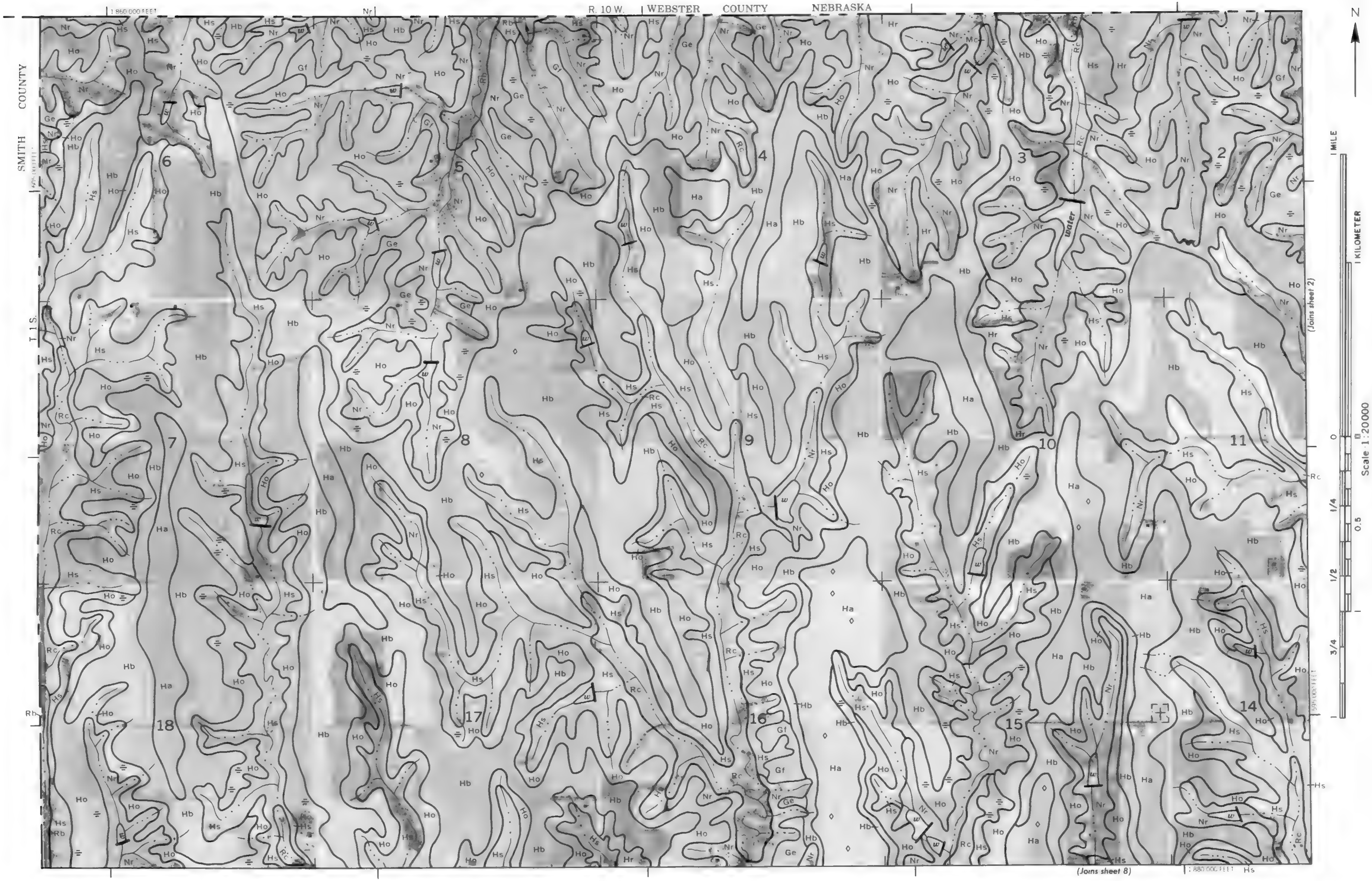
GULLY

DEPRESSION OR SINK

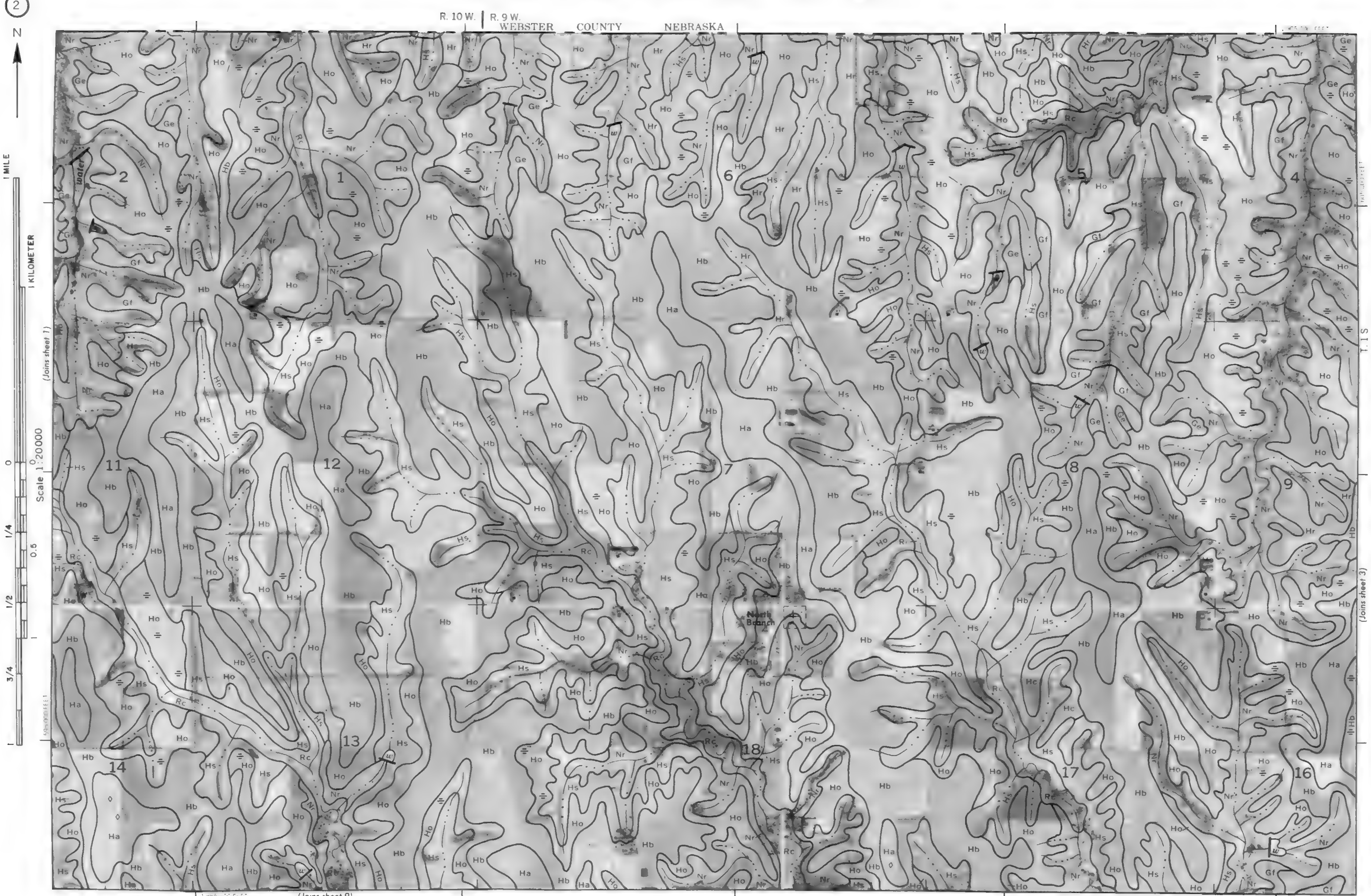
SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

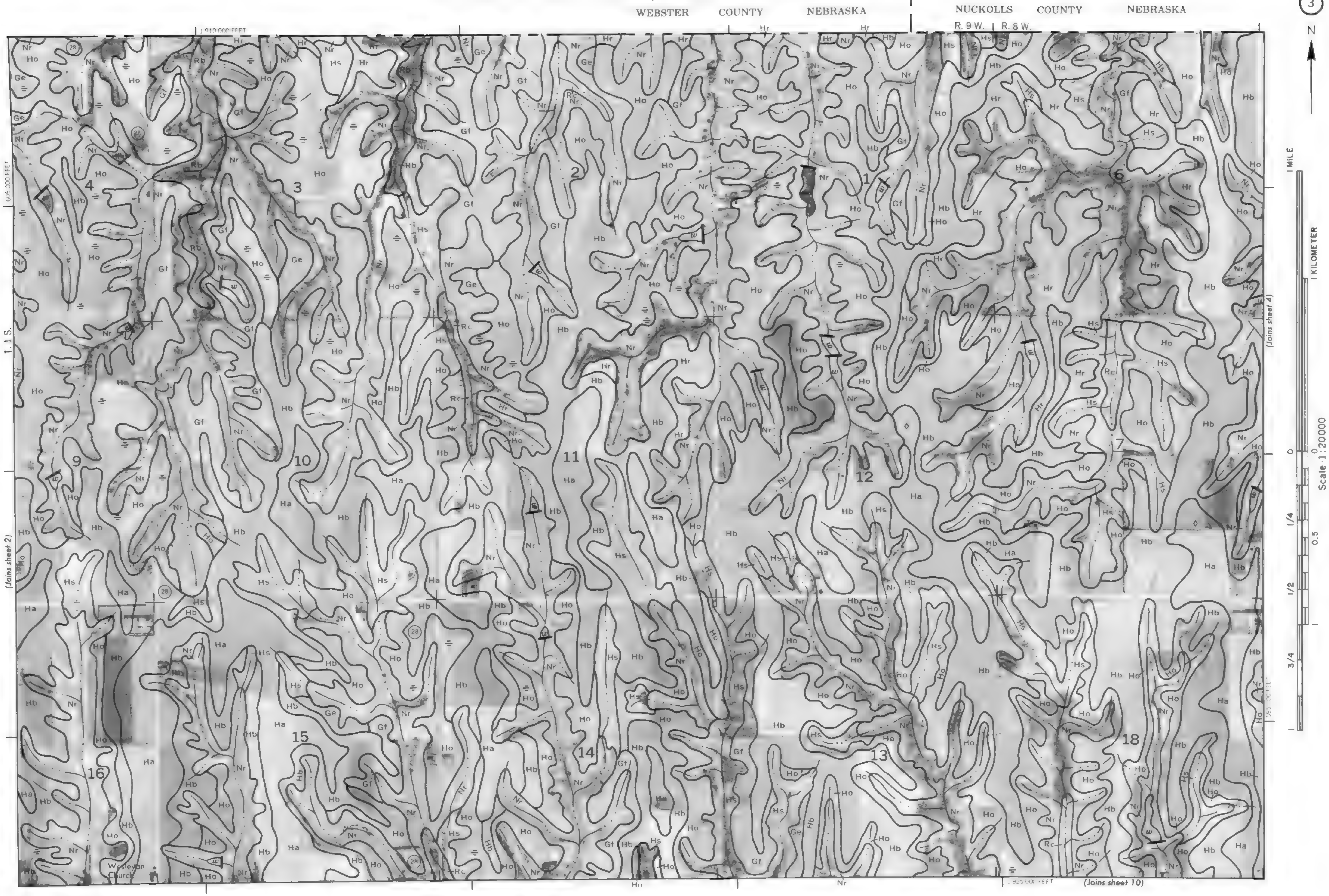
Blowout
Clay spot
Gravelly spot
Gumbo, slick or scabby spot (sodic)
Dumps and other similar non soil areas
Prominent hill or peak
Rock outcrop (includes sandstone and shale)
Saline spot
Sandy spot
Severely eroded spot
Slide or slip (tips point upslope)
Stony spot, very stony spot


R. 10 W.
WEBSTER COUNTY NEBRASKA
SMITH COUNTY
T 1 S.
1 860 000 FEET
1 880 000 FEET
(Joins sheet 2)
(Joins sheet 8)
N
1 MILE
1 KILOMETER
Scale 1:20000

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 2



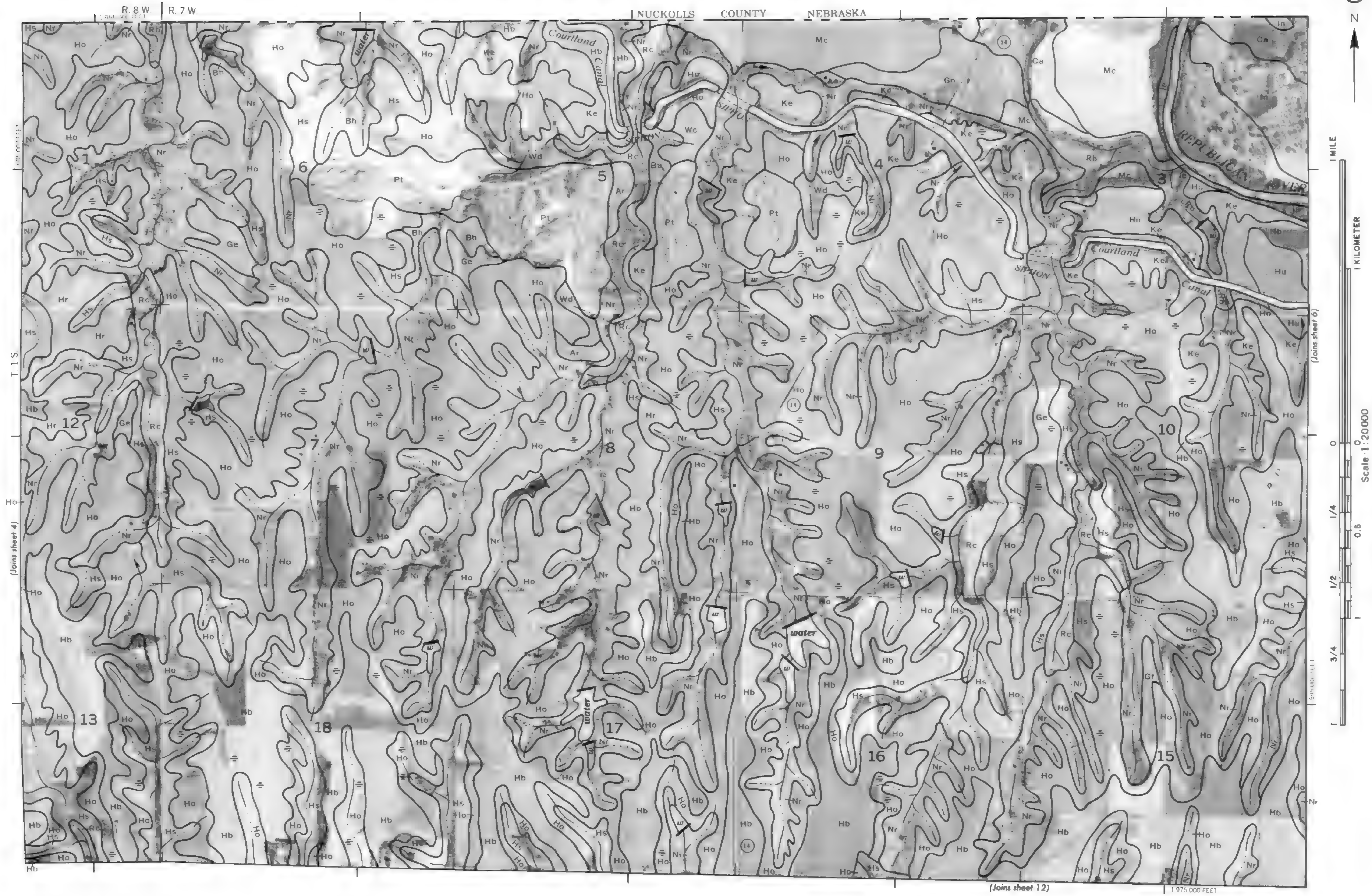
SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 3



SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 4

This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 5



SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 6

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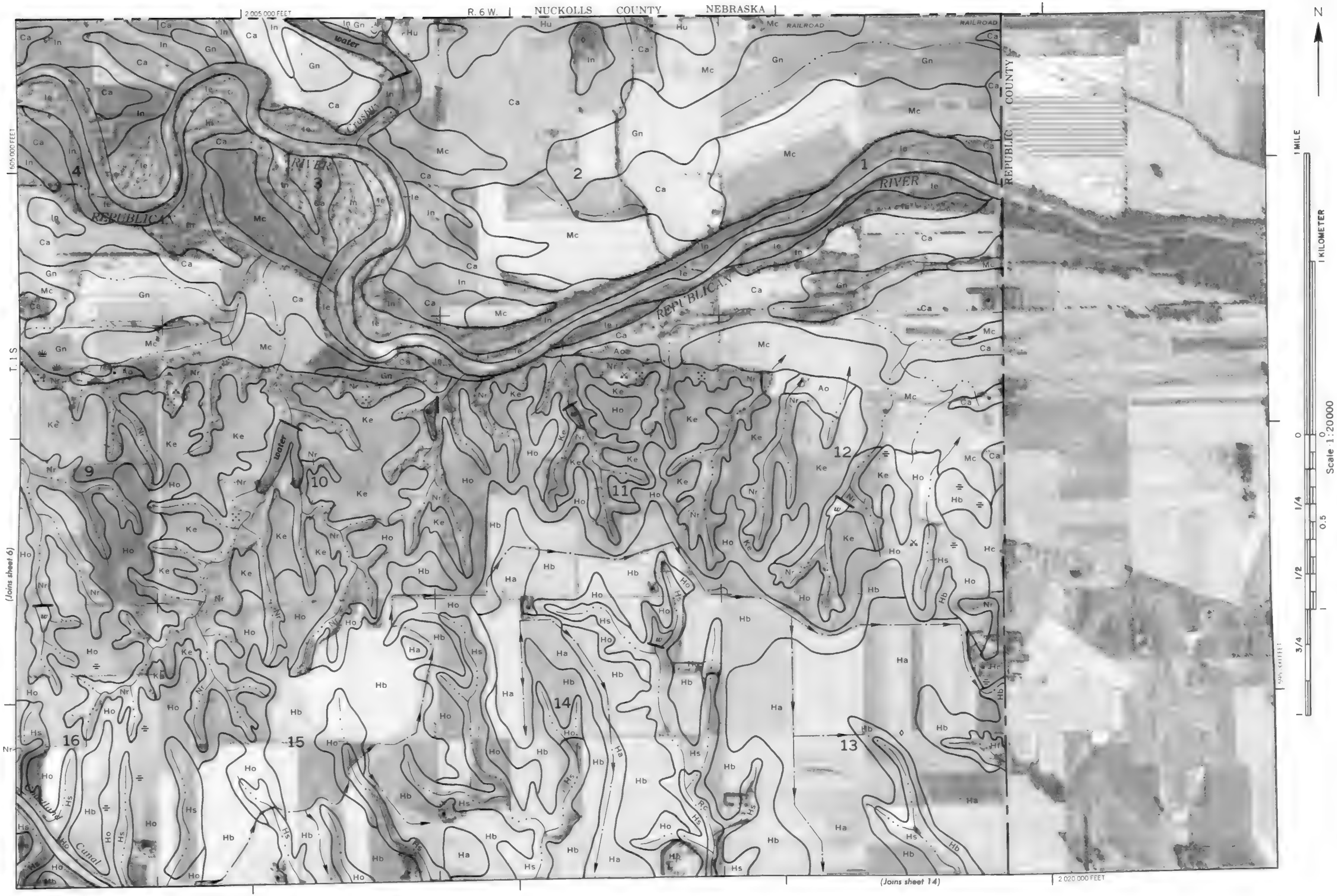
SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 7



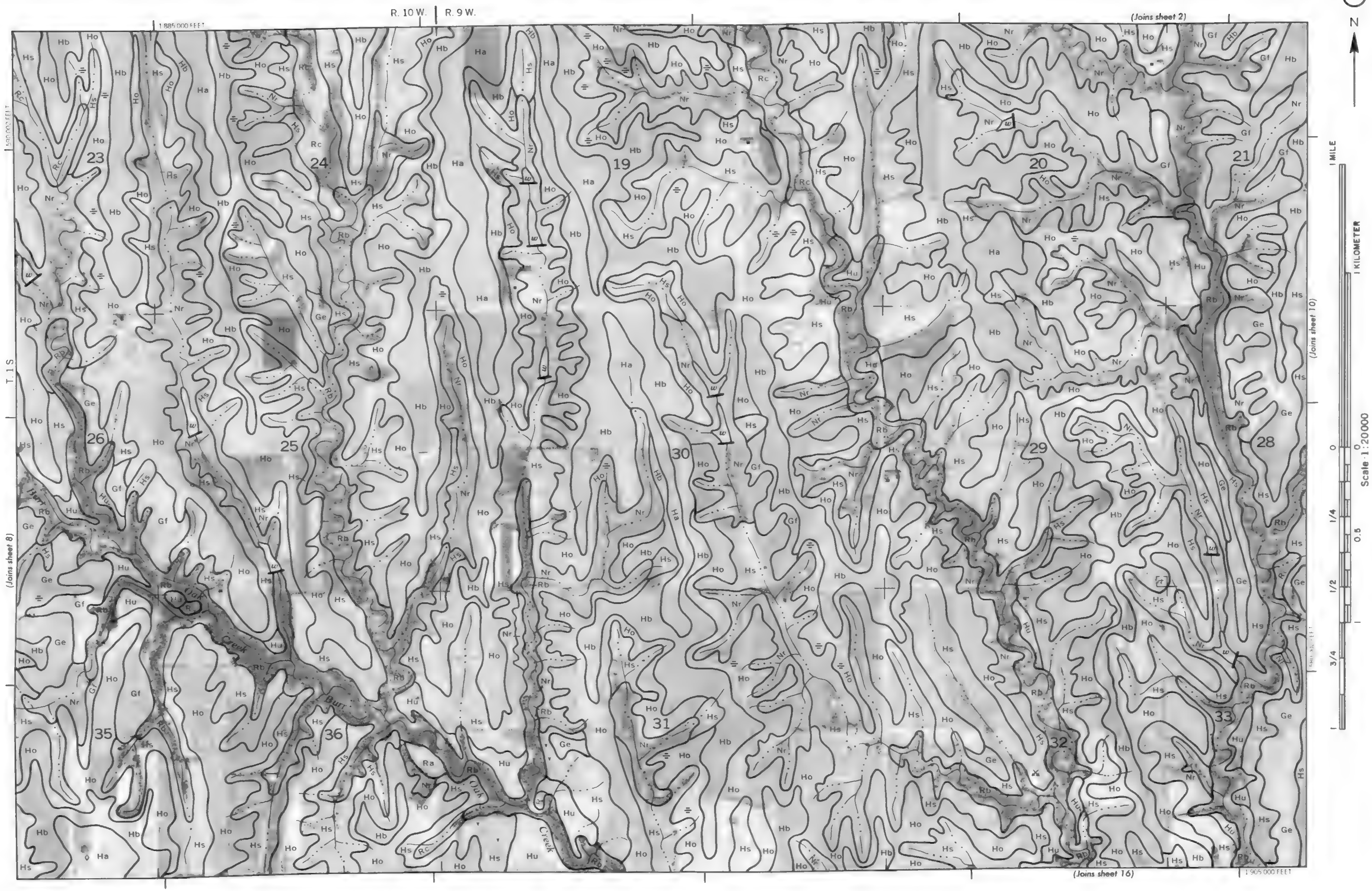
SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 8

N

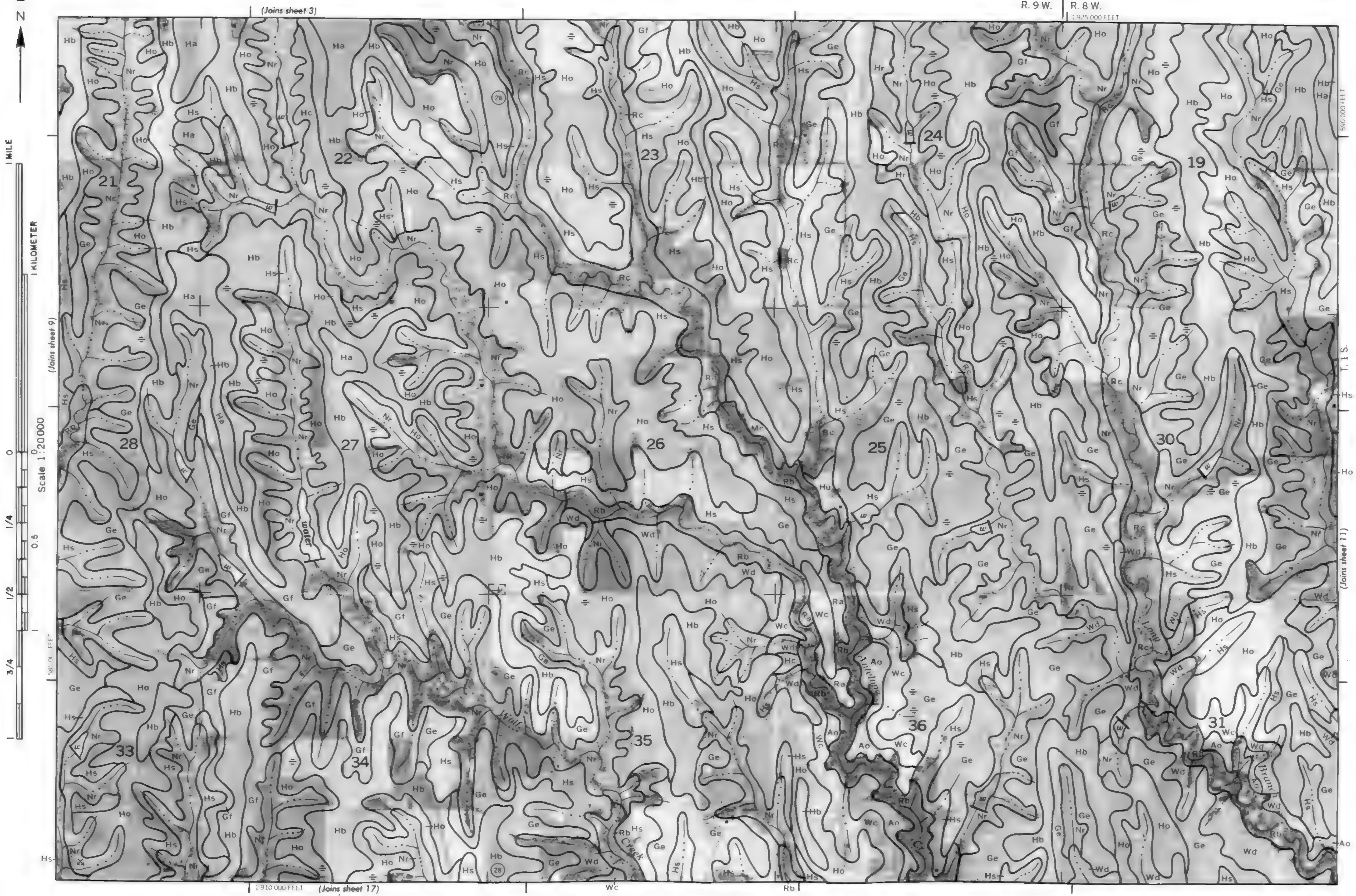
1 MILE
1 KILOMETER
Scale 1:20000
0 1/4 1/2 3/4 1
0 0.5 1

This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 9



SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 10



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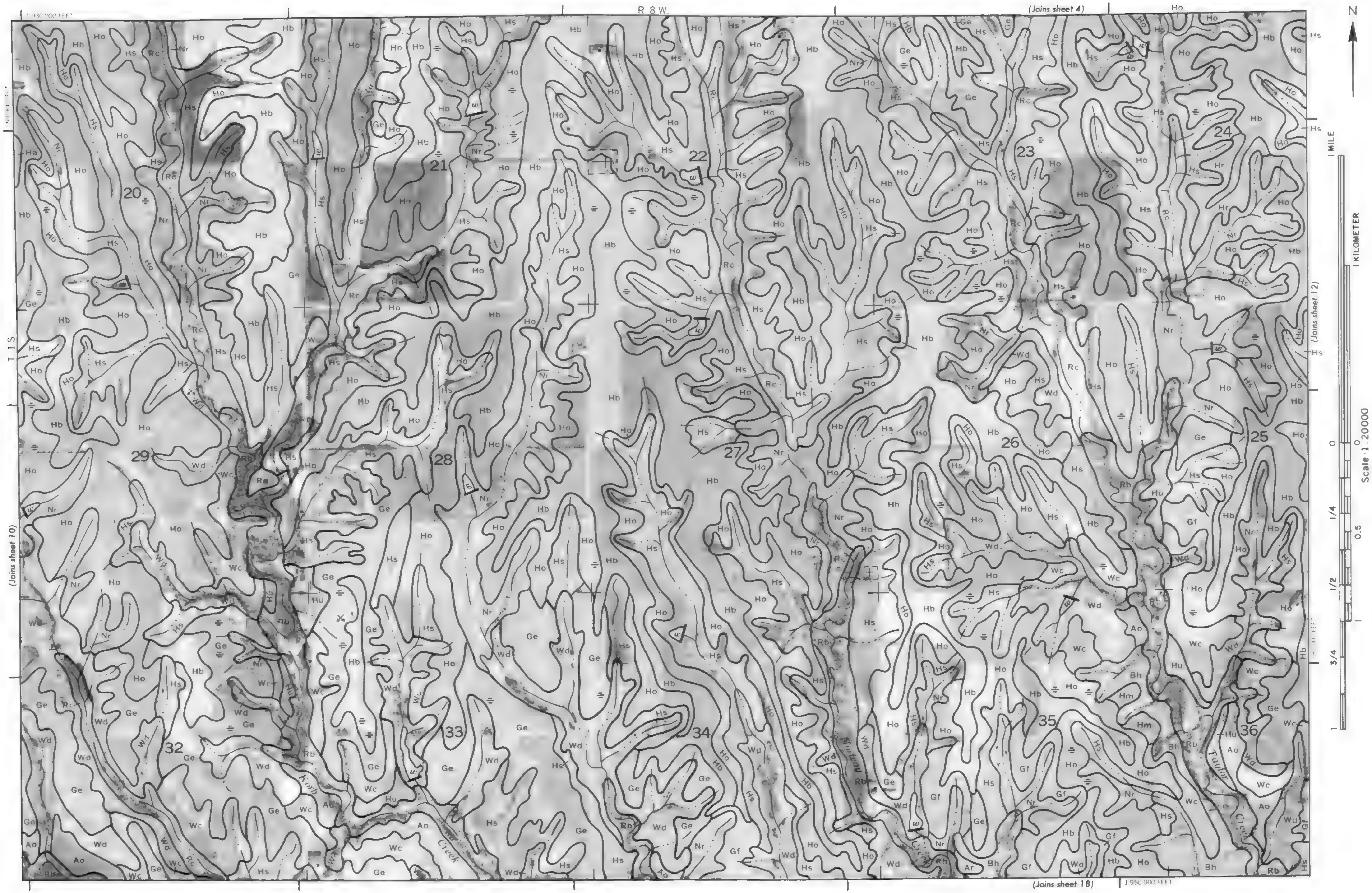
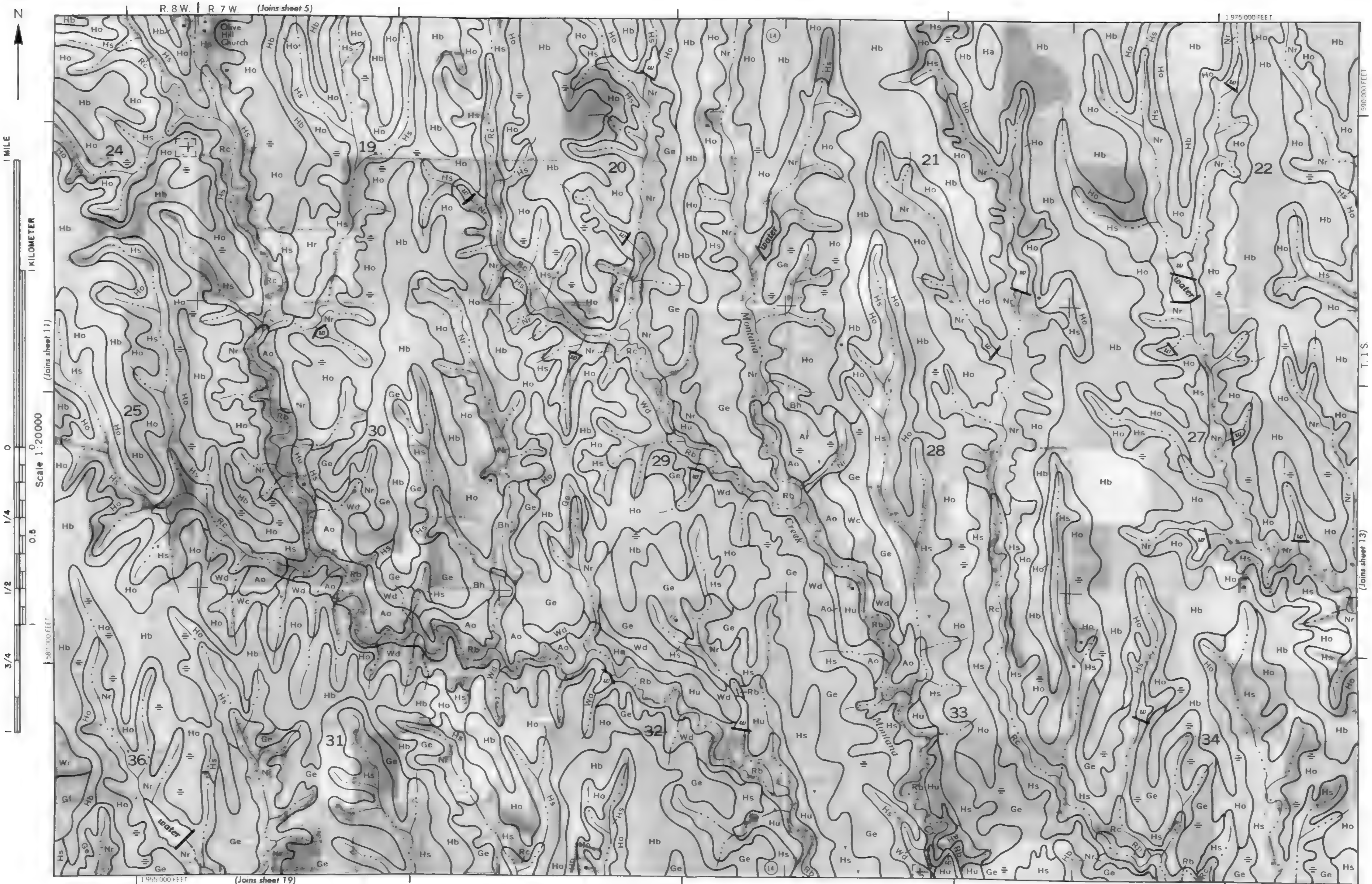
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



R 8 W.
(Joins sheet 4)
(Joins sheet 12)
(Joins sheet 18)
(Joins sheet 10)
T 1 S
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
1 950 000 FEET
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
Korb Creek
Norway Creek
Taylor Creek

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 12



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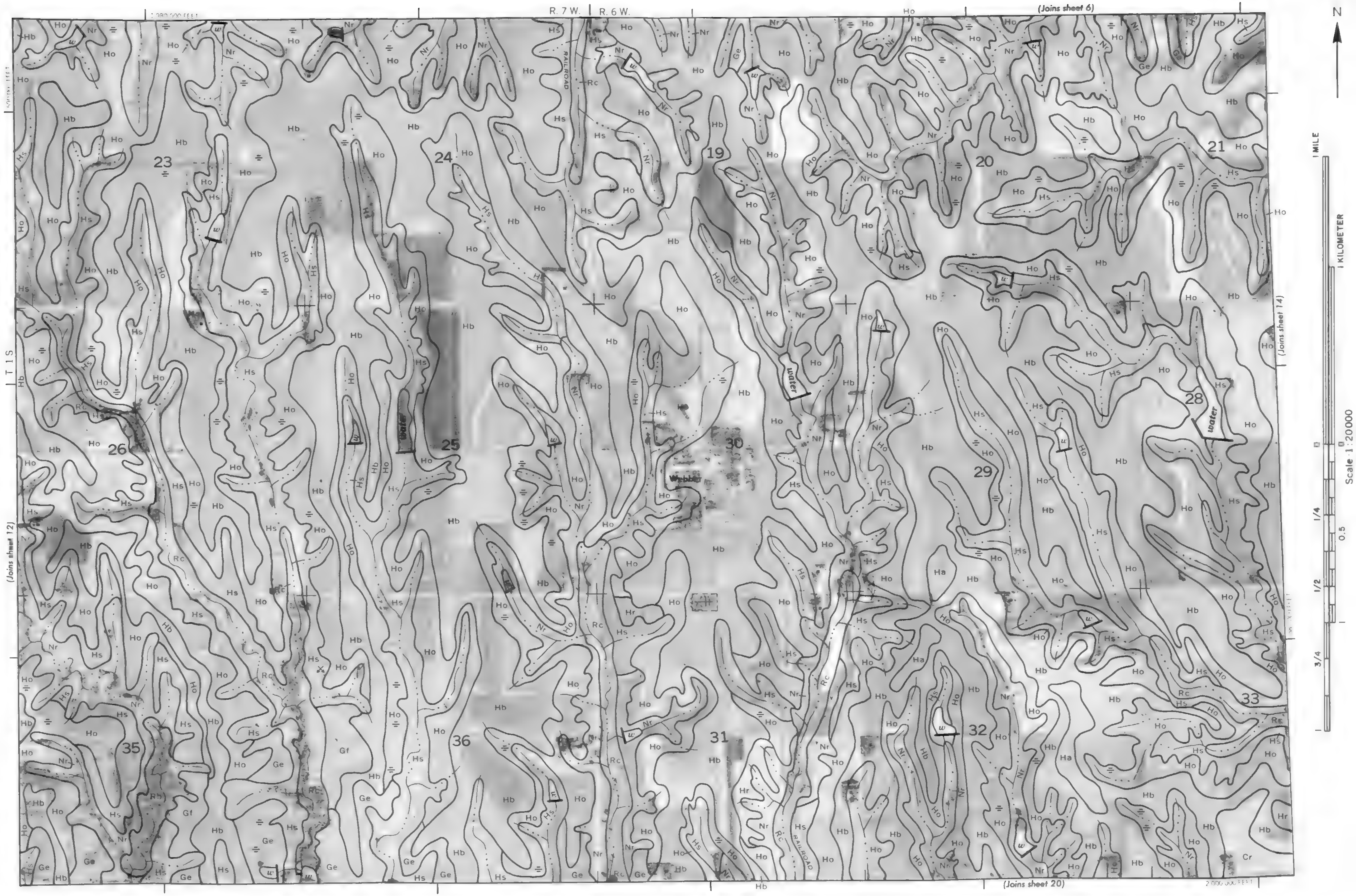
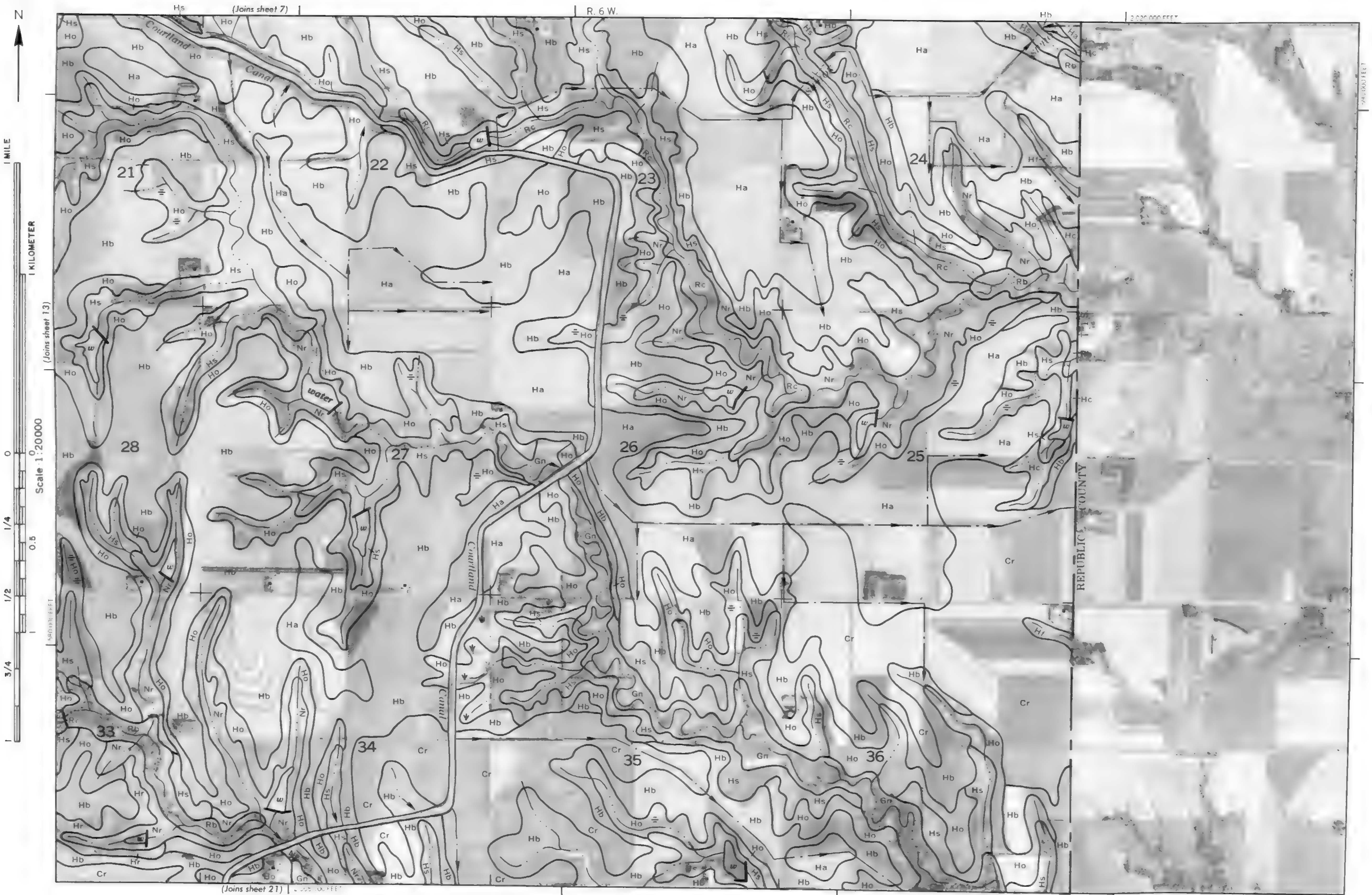
SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 13



SOIL MAP OF JEWELL COUNTY, KANSAS – SHEET NUMBER 14



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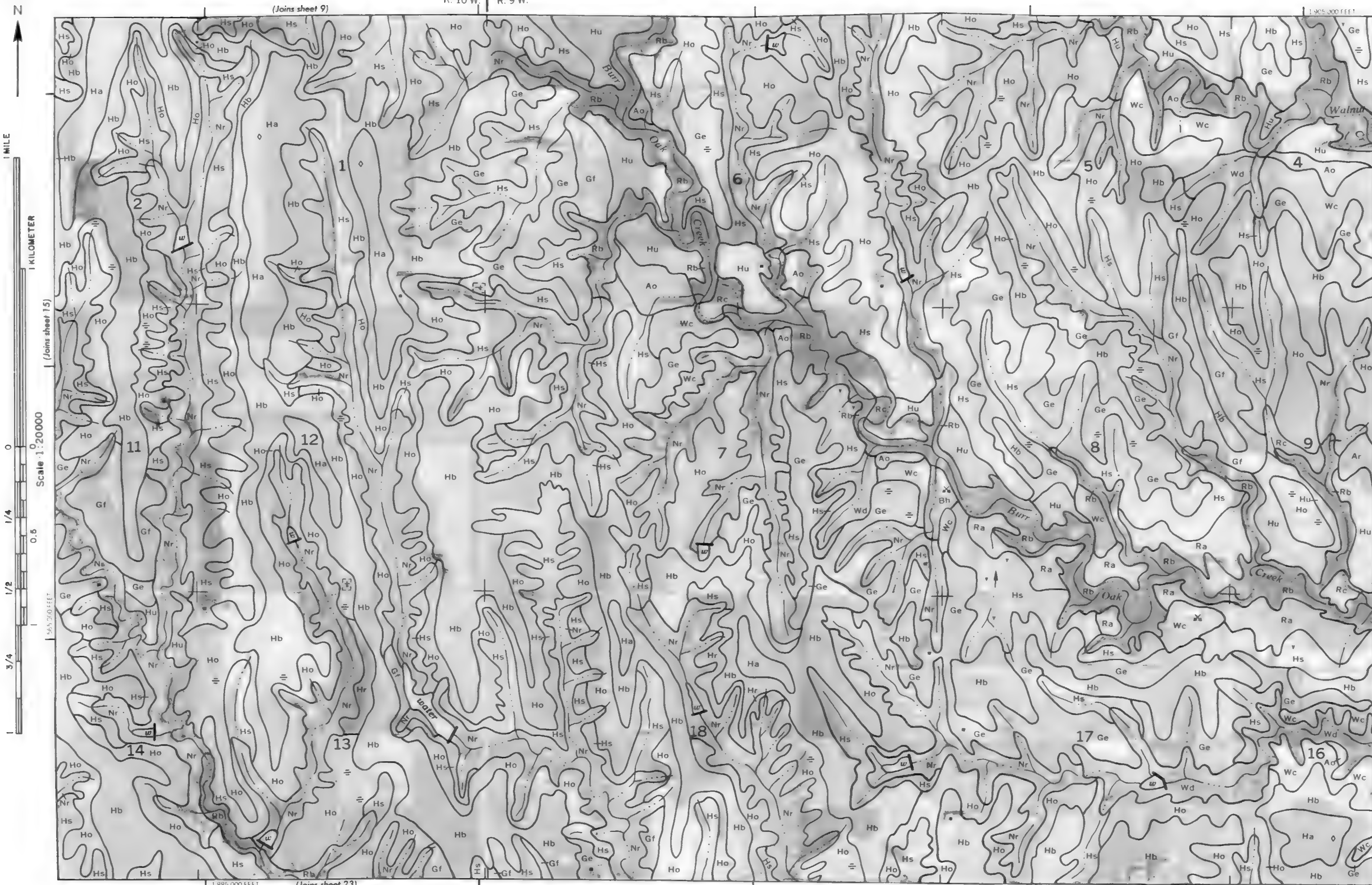
SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 15

(16)

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 16



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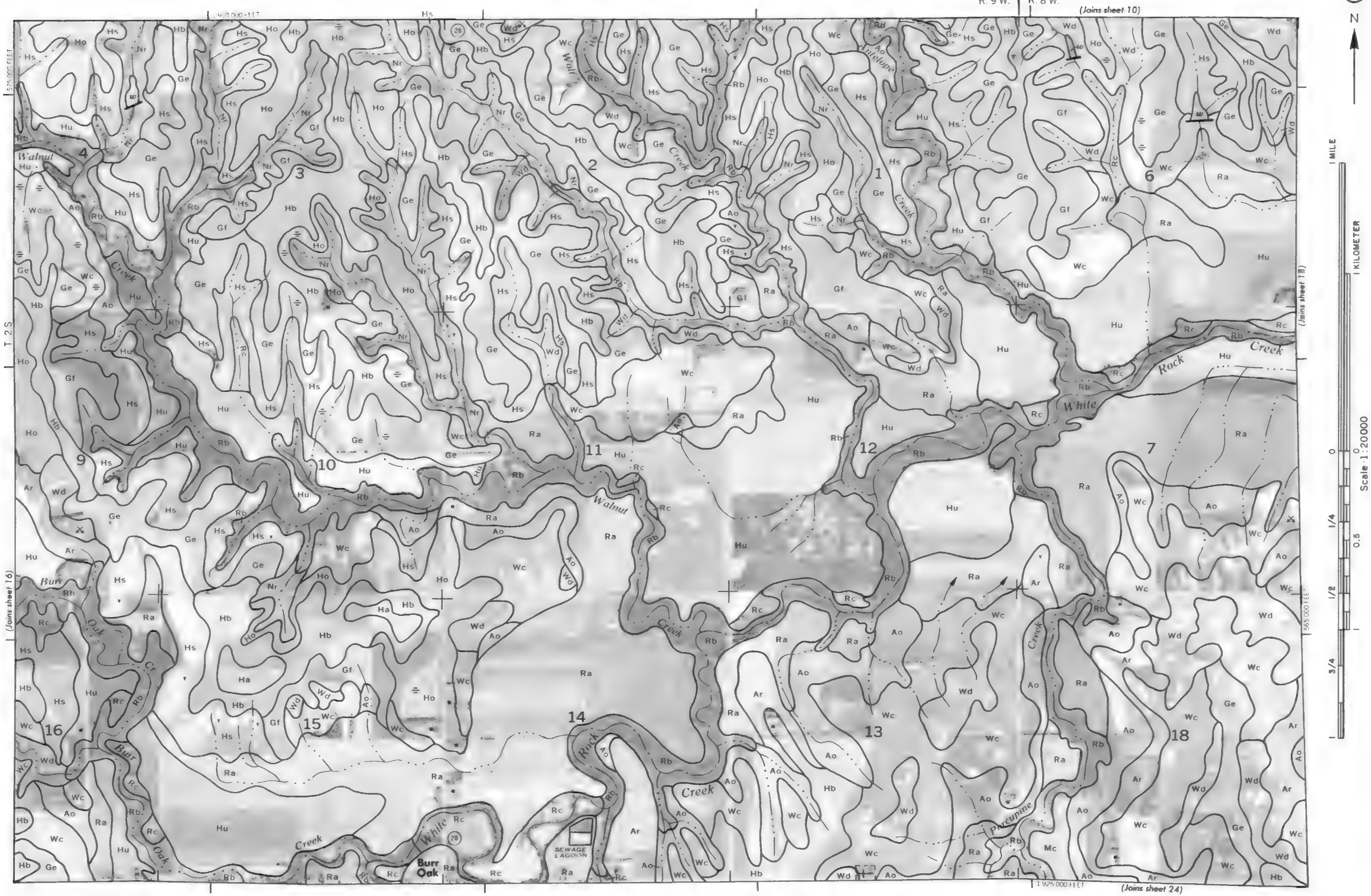
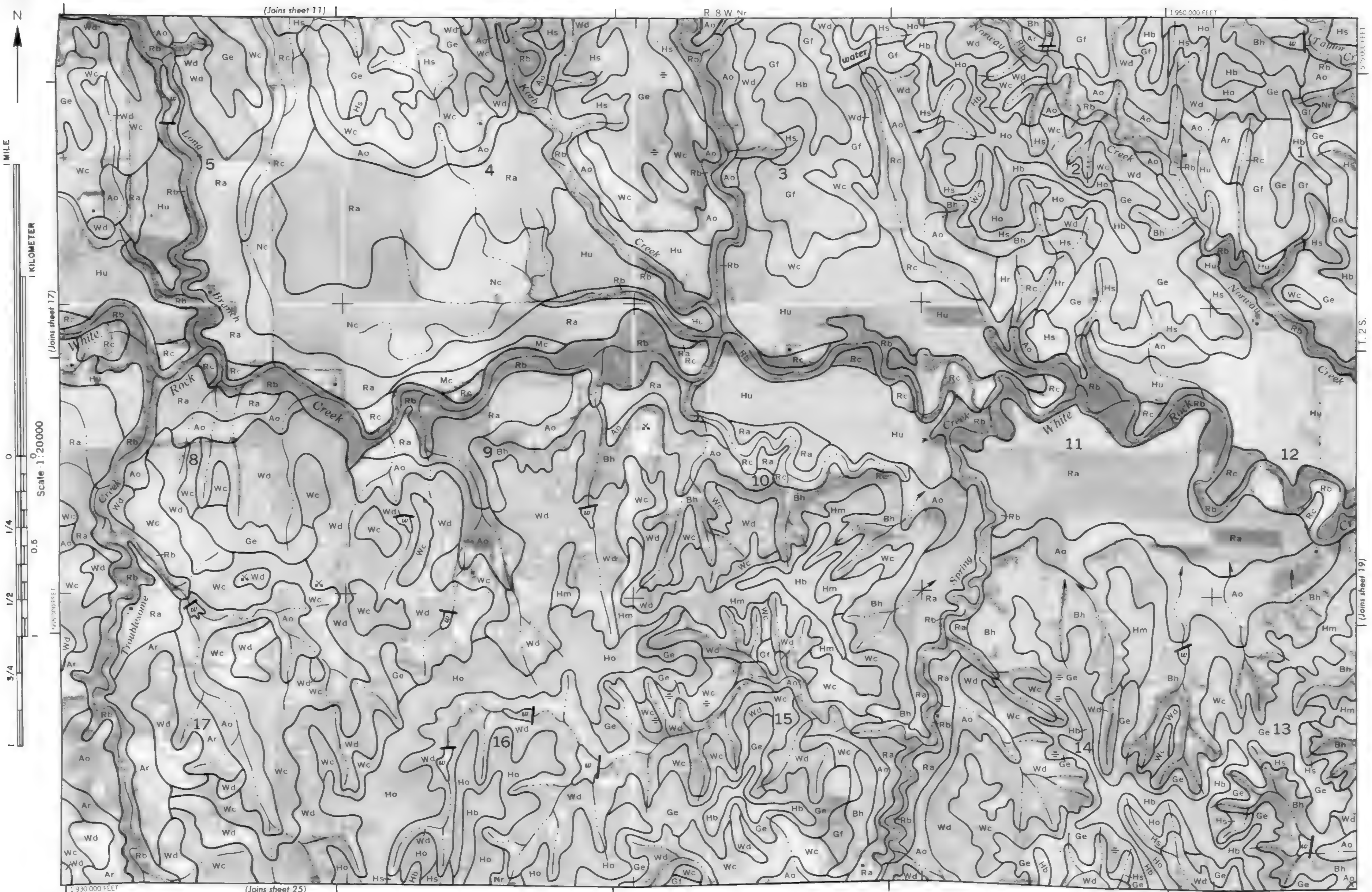
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 17



SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 18

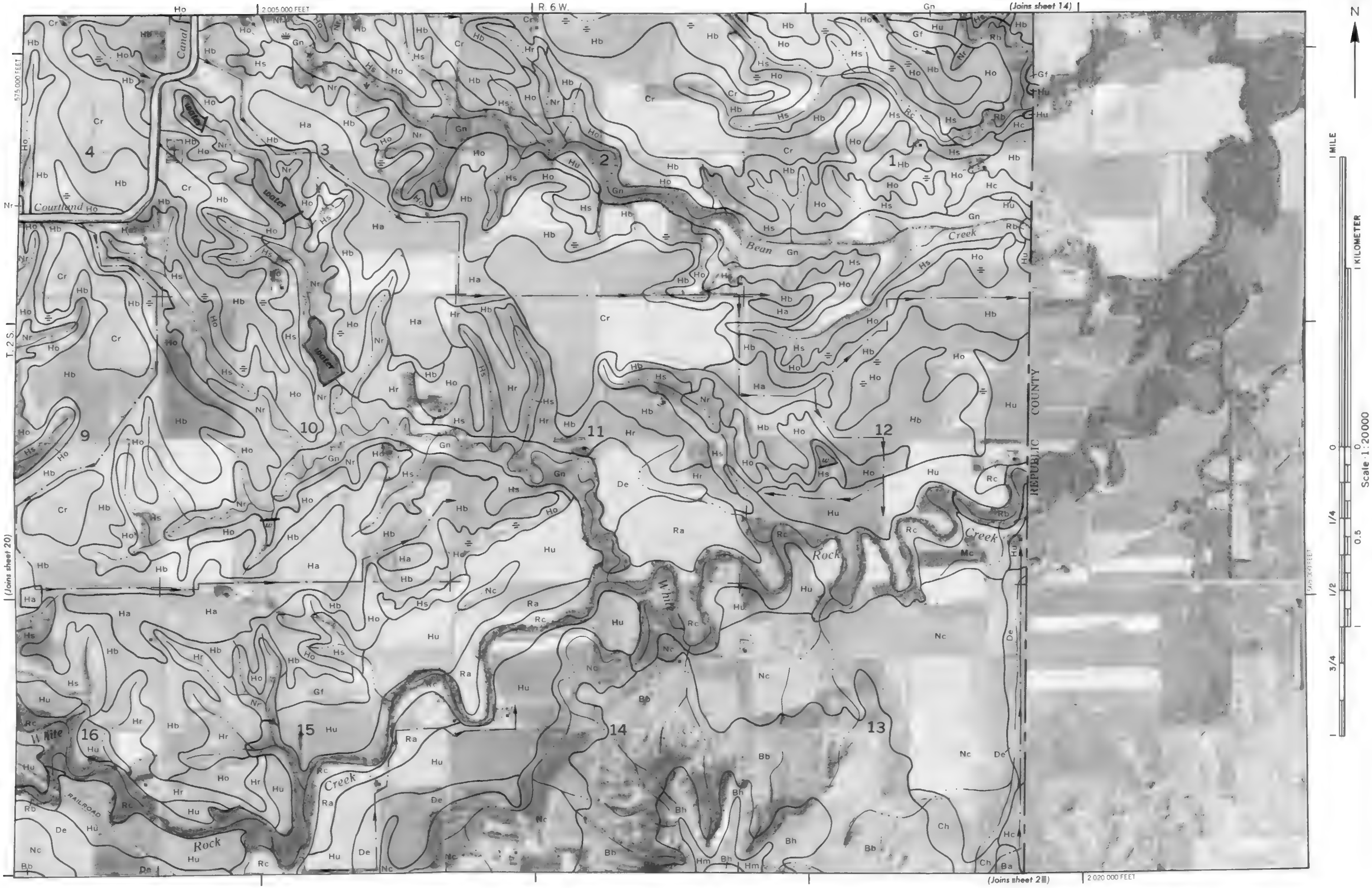


This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

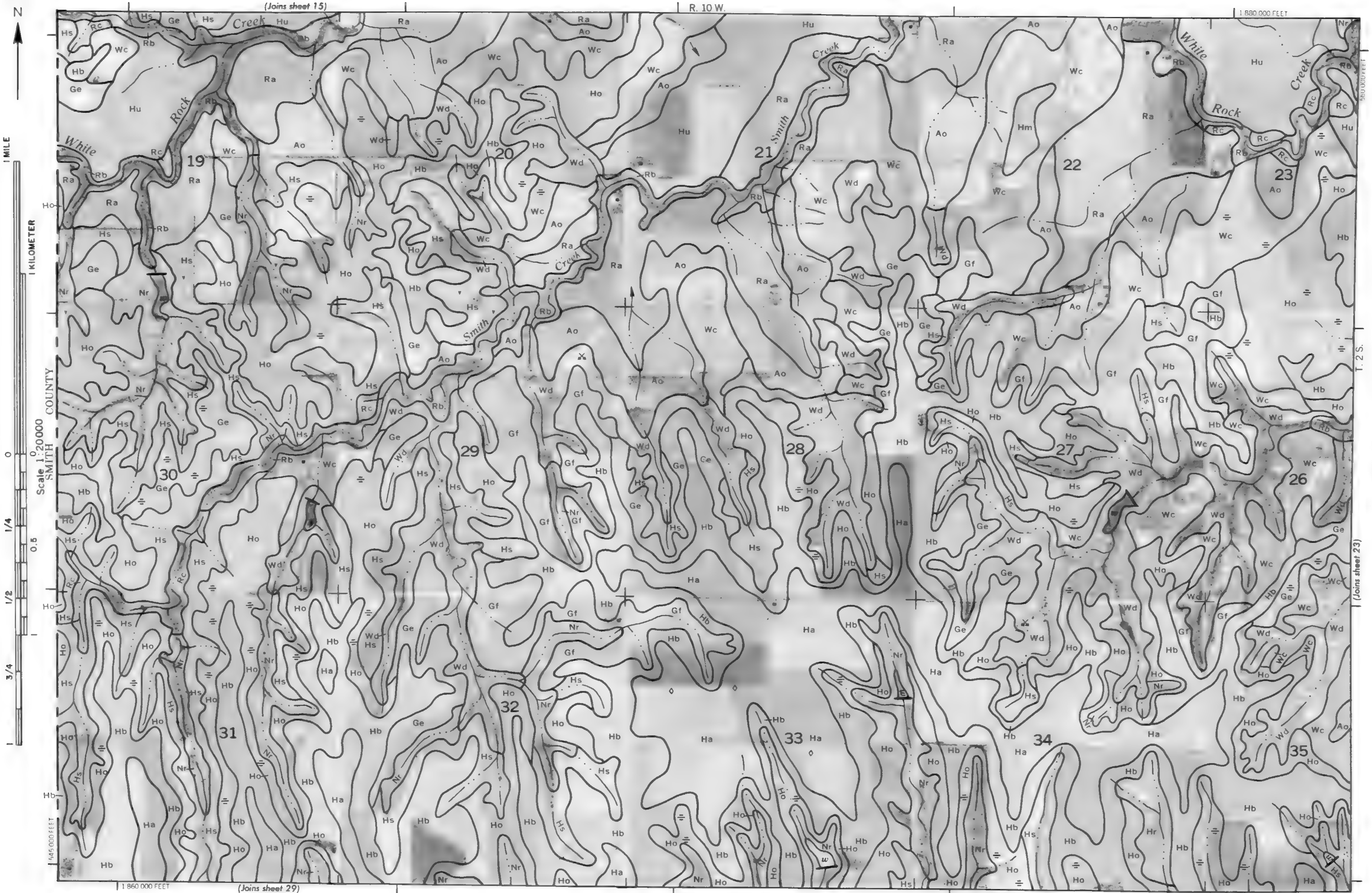

R. 8 W.
R. 7 W.
1 955 000 FEET
(Joins sheet 12)
(Joins sheet 20)
(Joins sheet 18)
(Joins sheet 26)
1 975 000 FEET
565 000 FEET
T. 2 S.
LOVEWELL RESERVOIR
Rock
Creek
White
Creek
Norway
Creek
Timber
Big
Johns
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 20

This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned


R. 6 W.
(Joins sheet 14)
2 005 000 FEET
575 000 FEET
T. 2 S.
(Joins sheet 20)
(Joins sheet 28)
2 020 000 FEET
Courtland
Canal
Bean Creek
Rock Creek
White Rock Creek
RAILROAD
REPUBLIC COUNTY
N
1 MILE
1 KILOMETER
Scale 1:20000

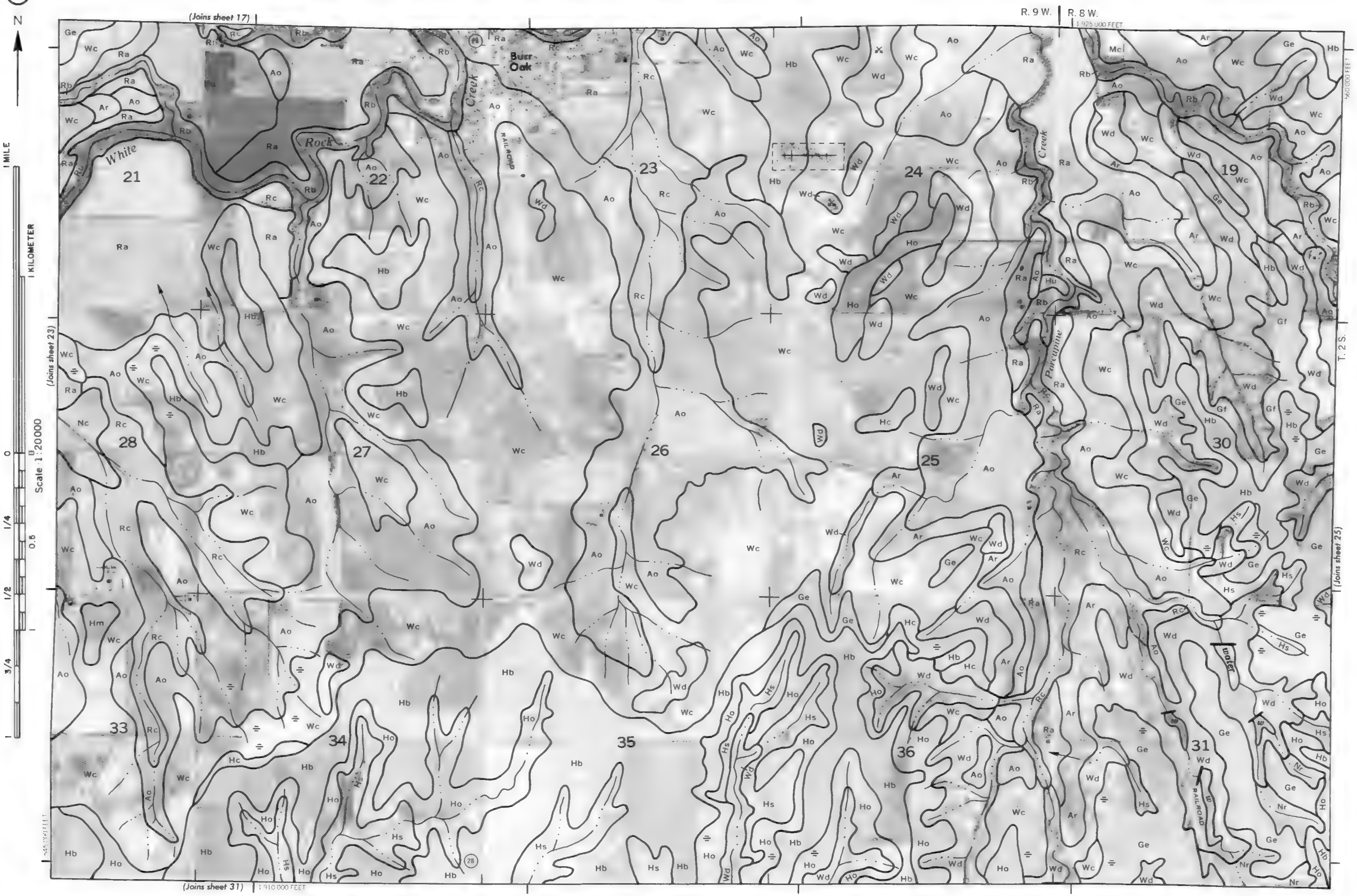
SOIL MAP OF JEWELL COUNTY, KANSAS — SHEET NUMBER 22



This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

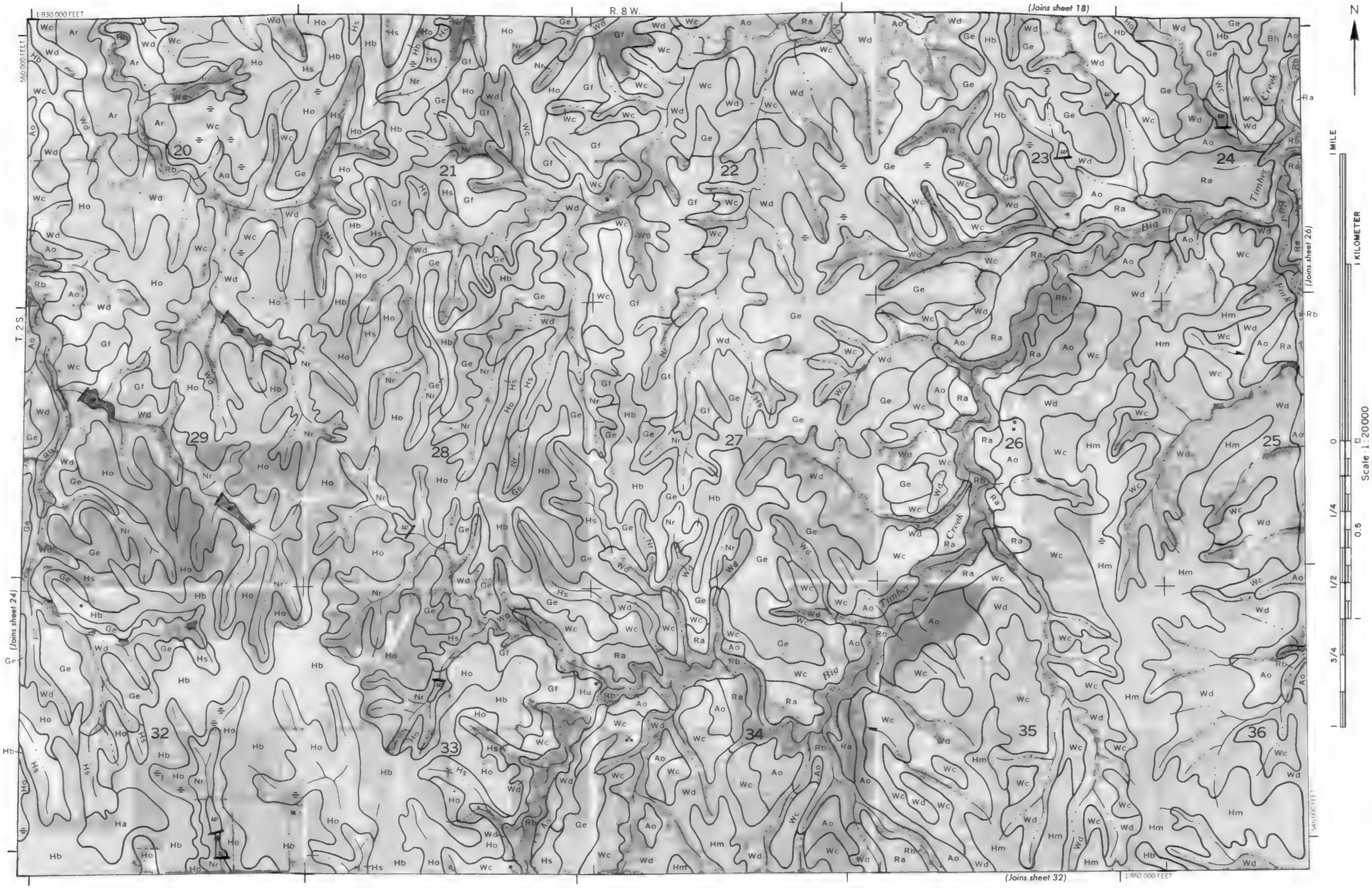
SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 23

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 24



This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

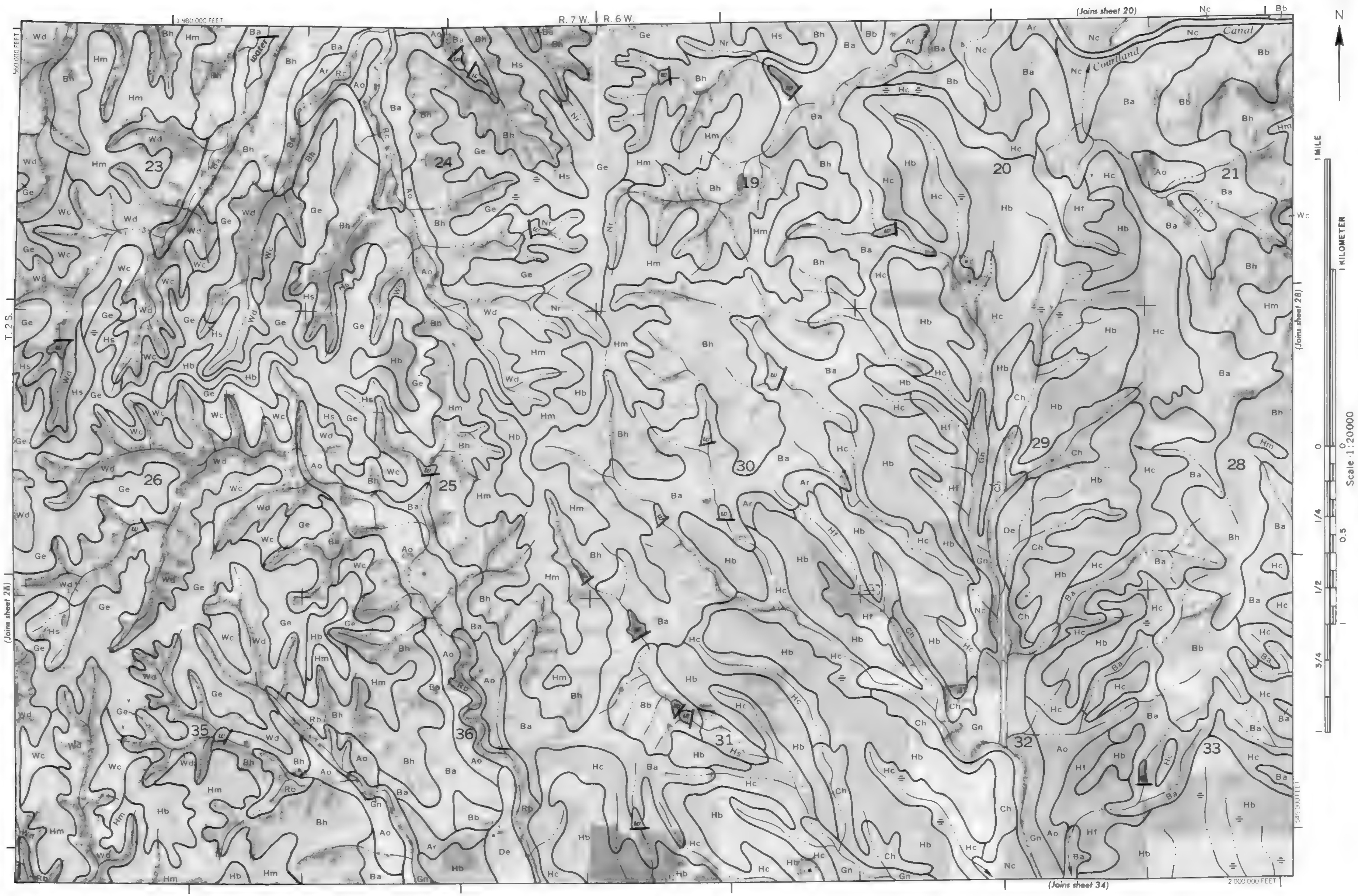
SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 25



SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 26

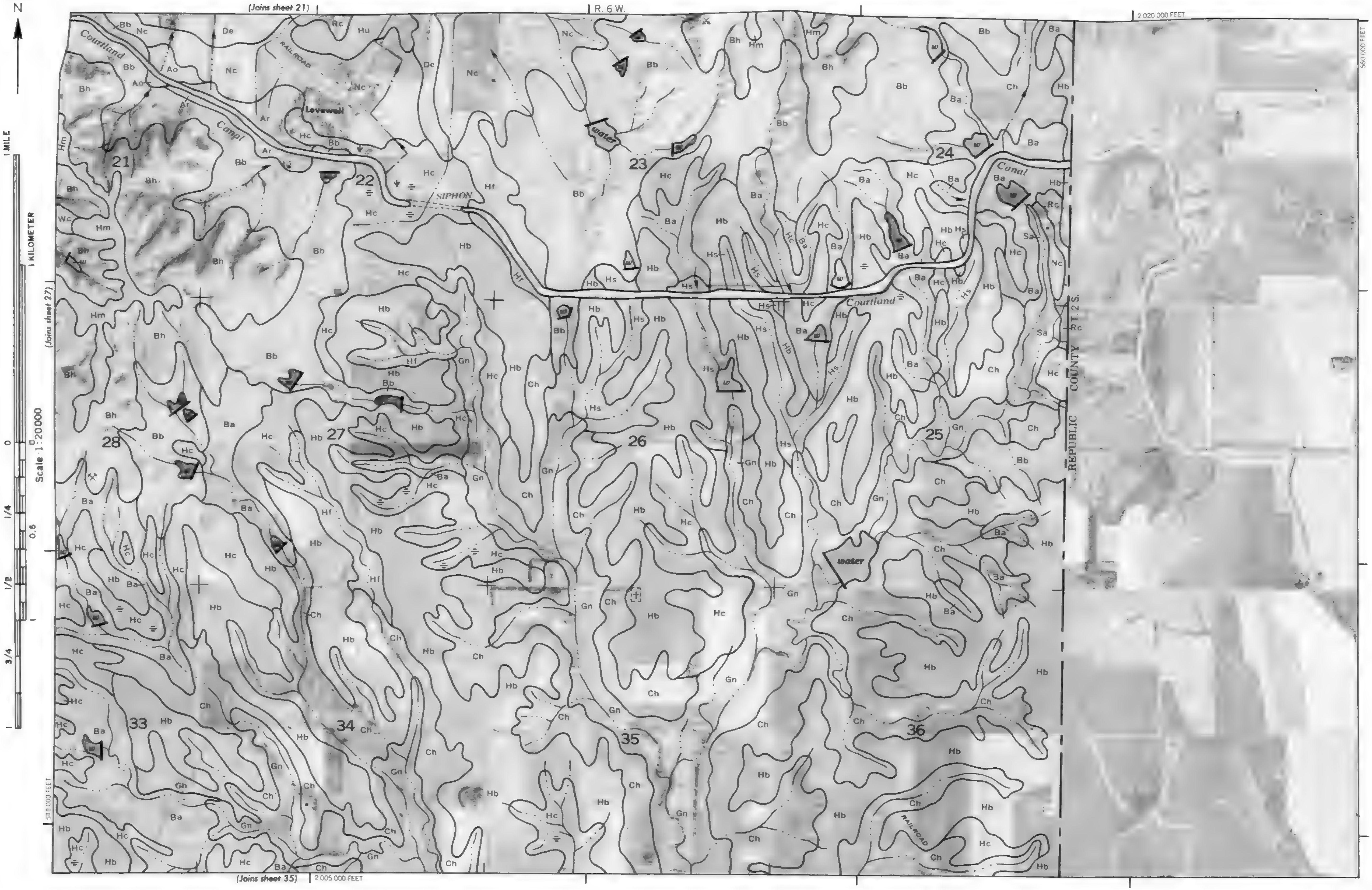
This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 27



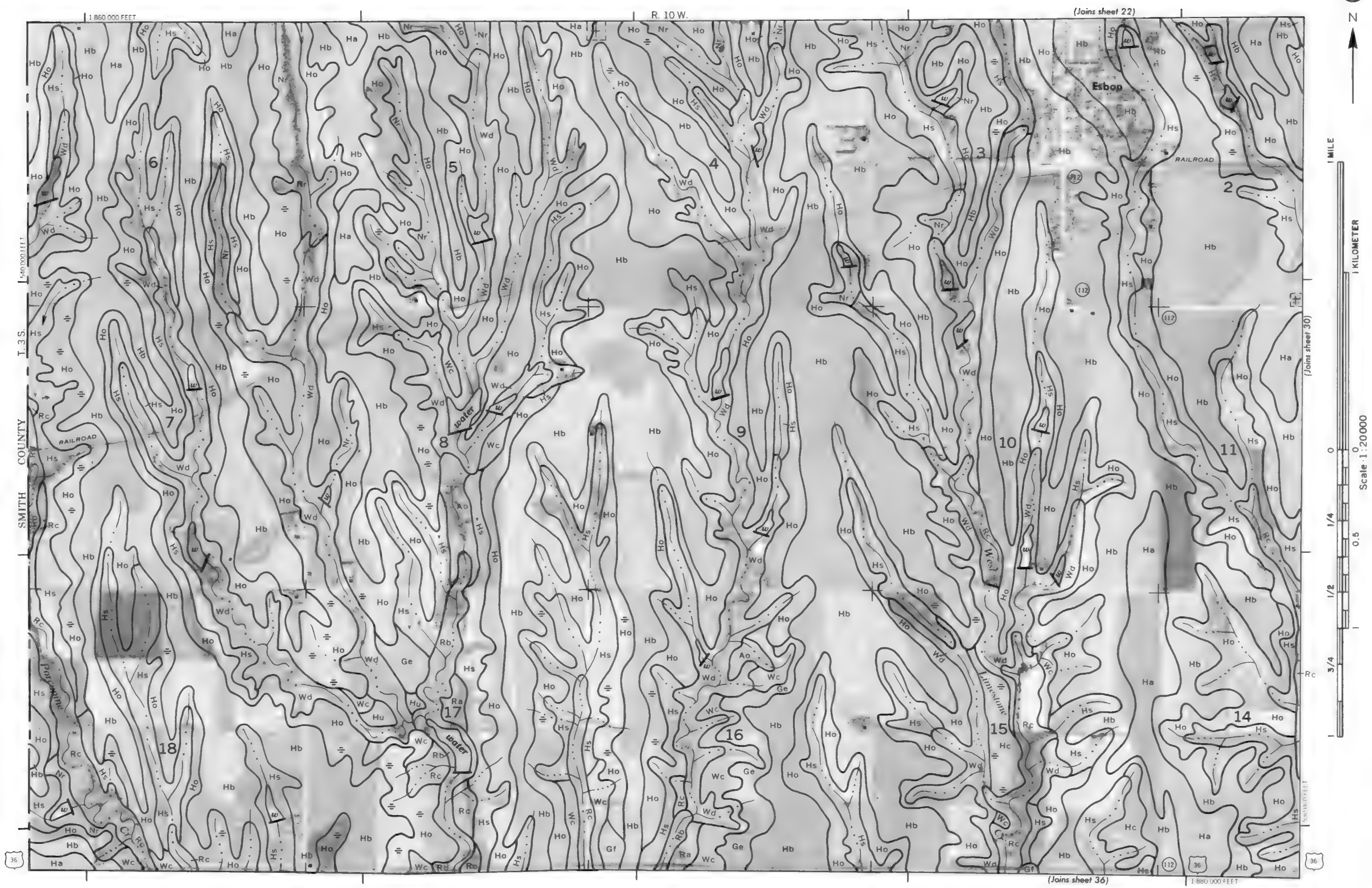
This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 28



This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 29



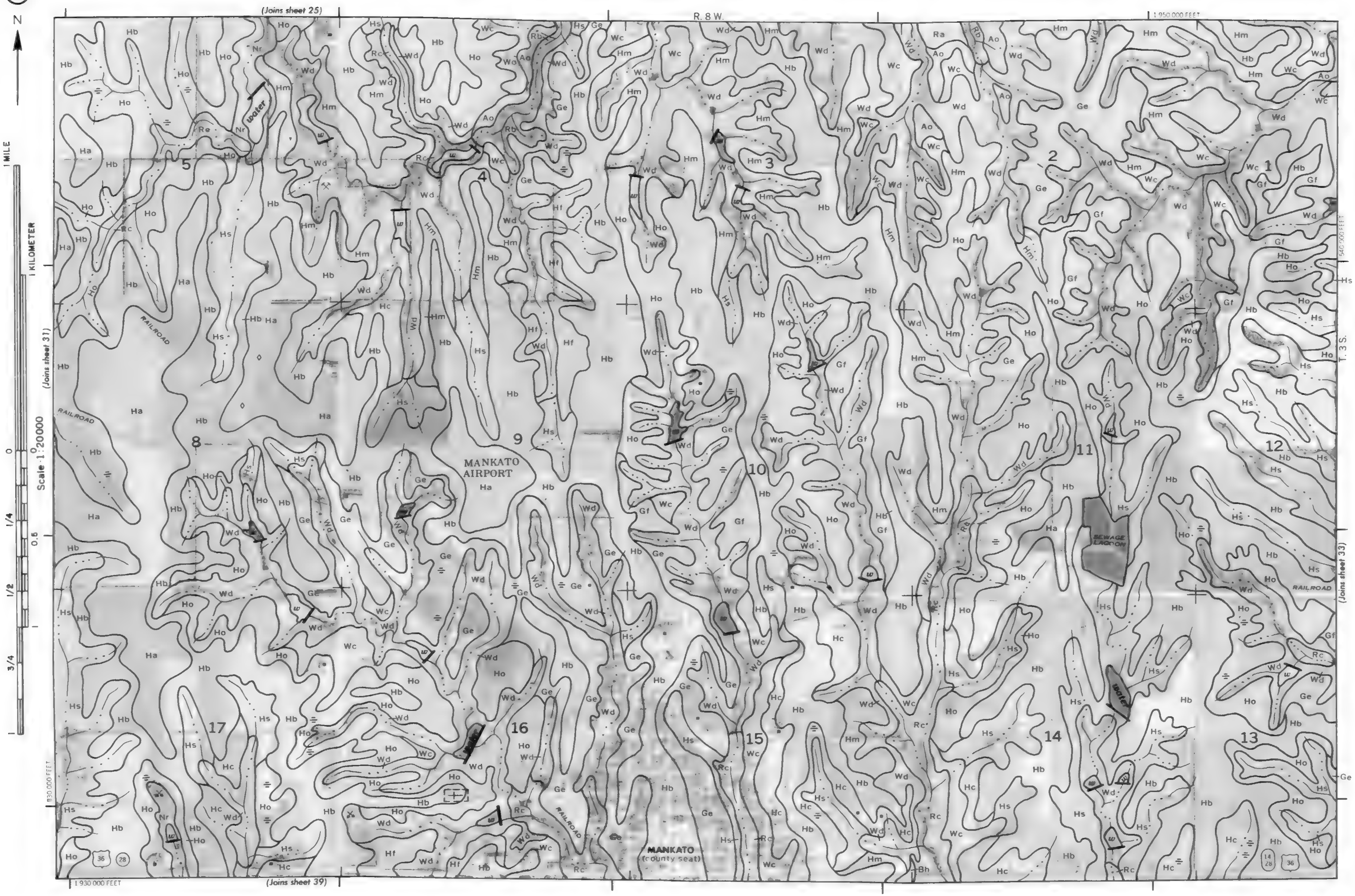
This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 30

This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

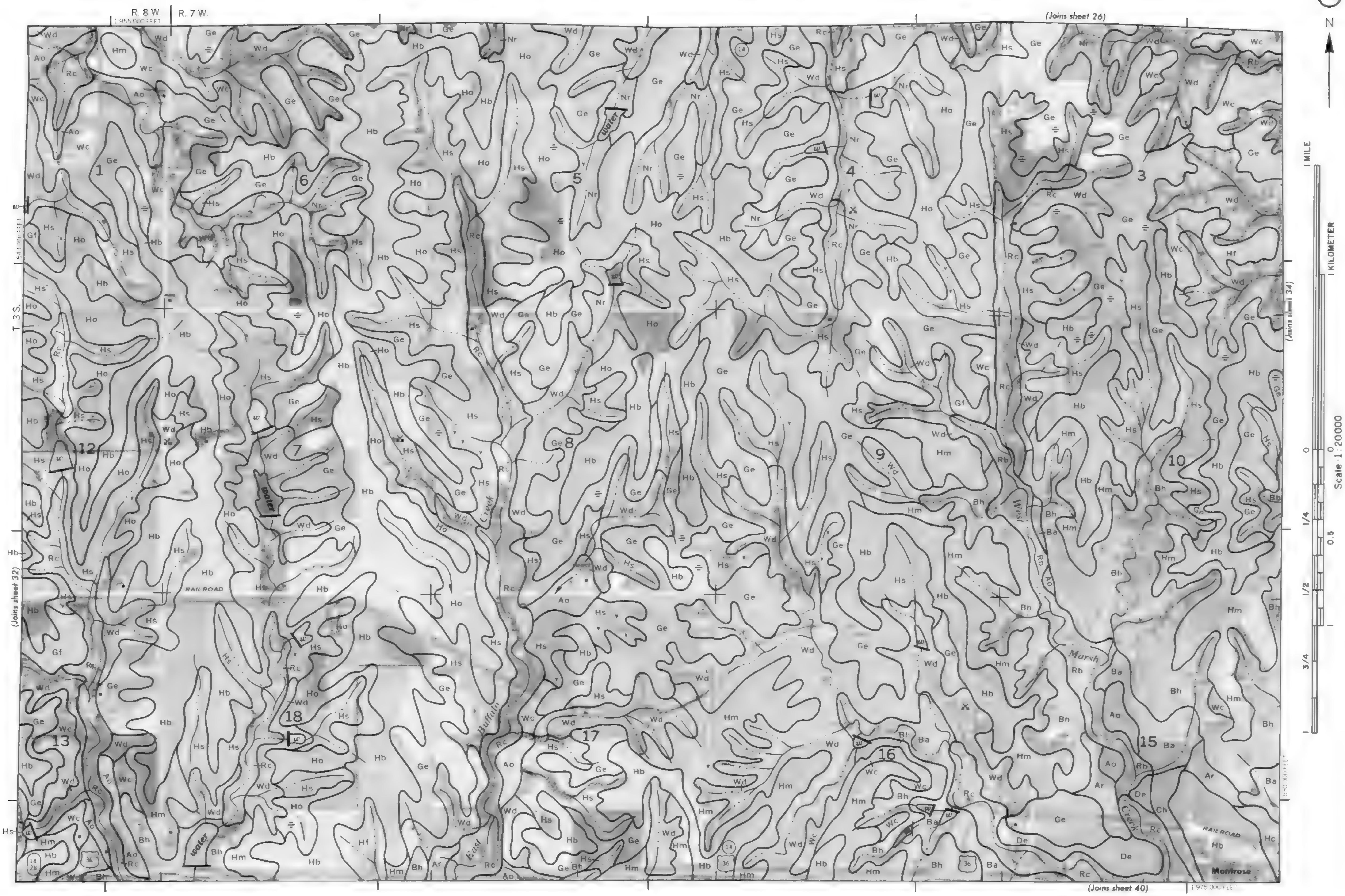

R. 9 W.
R. 8 W.
(Joins sheet 24)
(Joins sheet 32)
(Joins sheet 30)
(Joins sheet 38)
T. 3 S.
1 910 000 FEET
1 925 000 FEET
540 000 FEET
530 000 FEET
RAILROAD
water
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
1
2
3
4
6
7
9
10
11
12
13
14
15
16
18
28
36
Hb
Ho
Hs
Wd
Wc
Rc
Ha
Hc
Hf
Hr
Nr
Ge
Gf
Ao
Ra
Rb
w

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 32

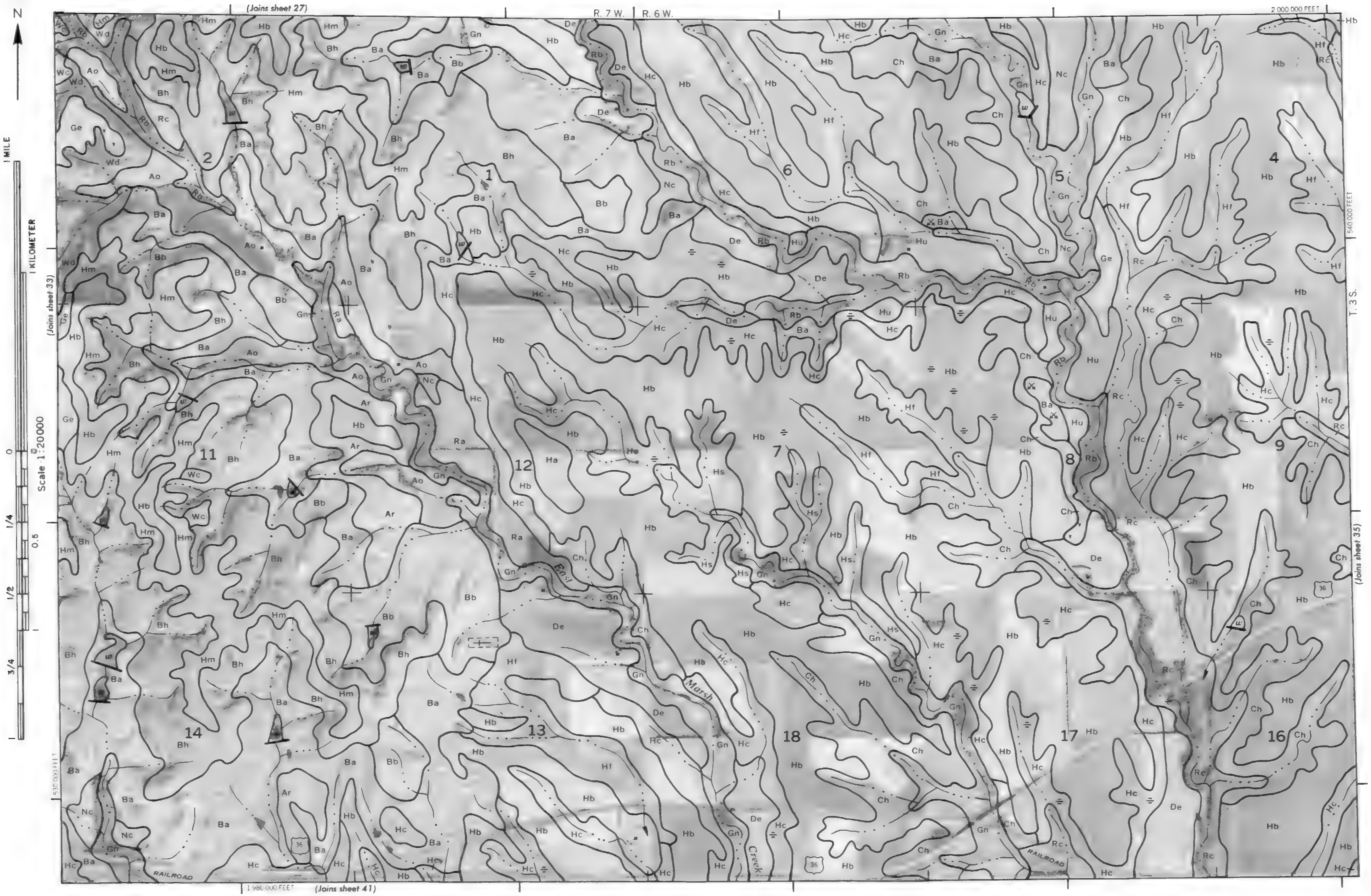


This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 33



SOIL MAP OF JEWELL COUNTY, KANSAS — SHEET NUMBER 34



This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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Coordinate grid ticks and land division corners, if shown, are approximately positioned.

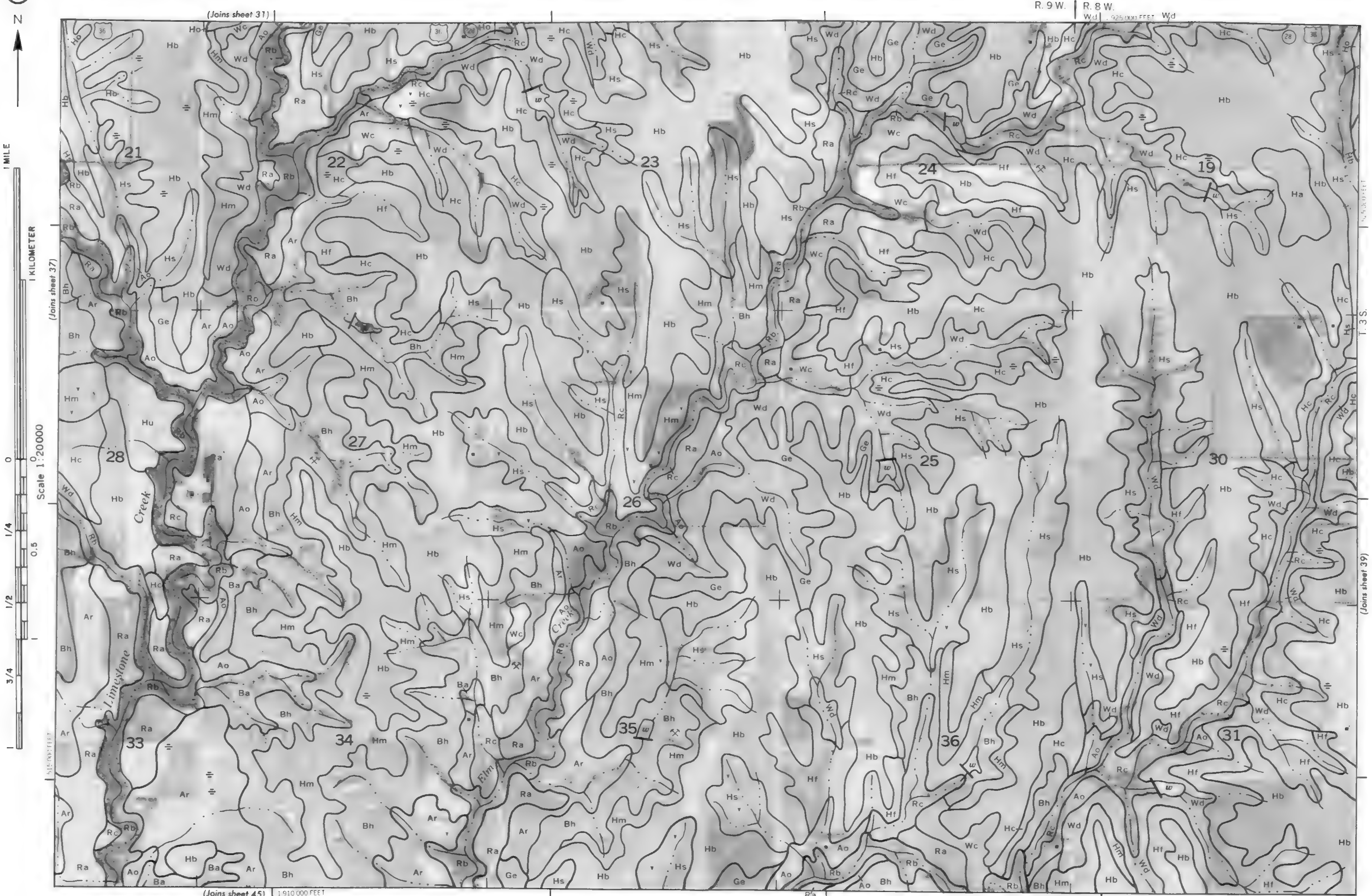
SOIL MAP OF JEWELL COUNTY, KANSAS – SHEET NUMBER 36

This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 37

This soil survey map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 38



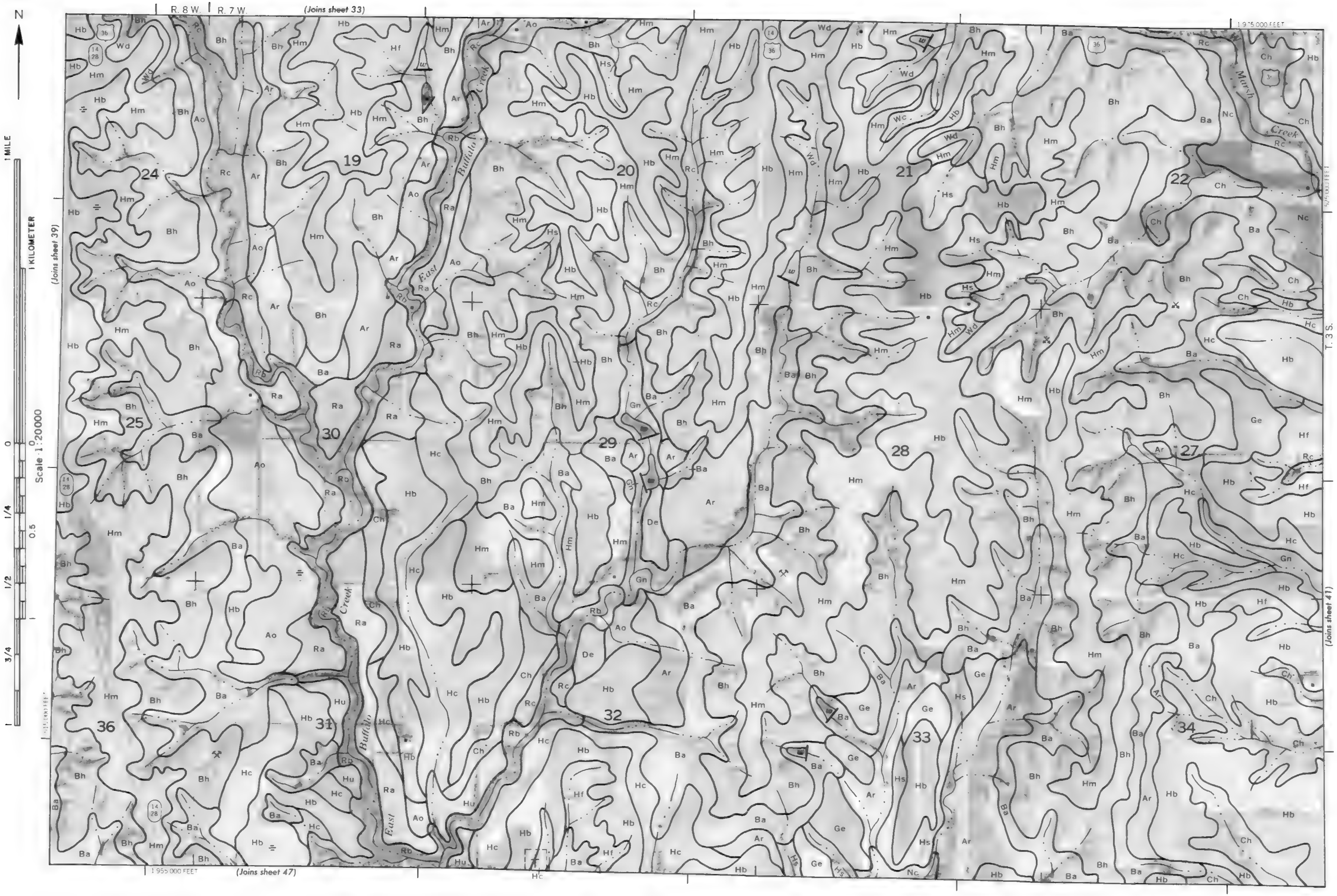
This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 39

39

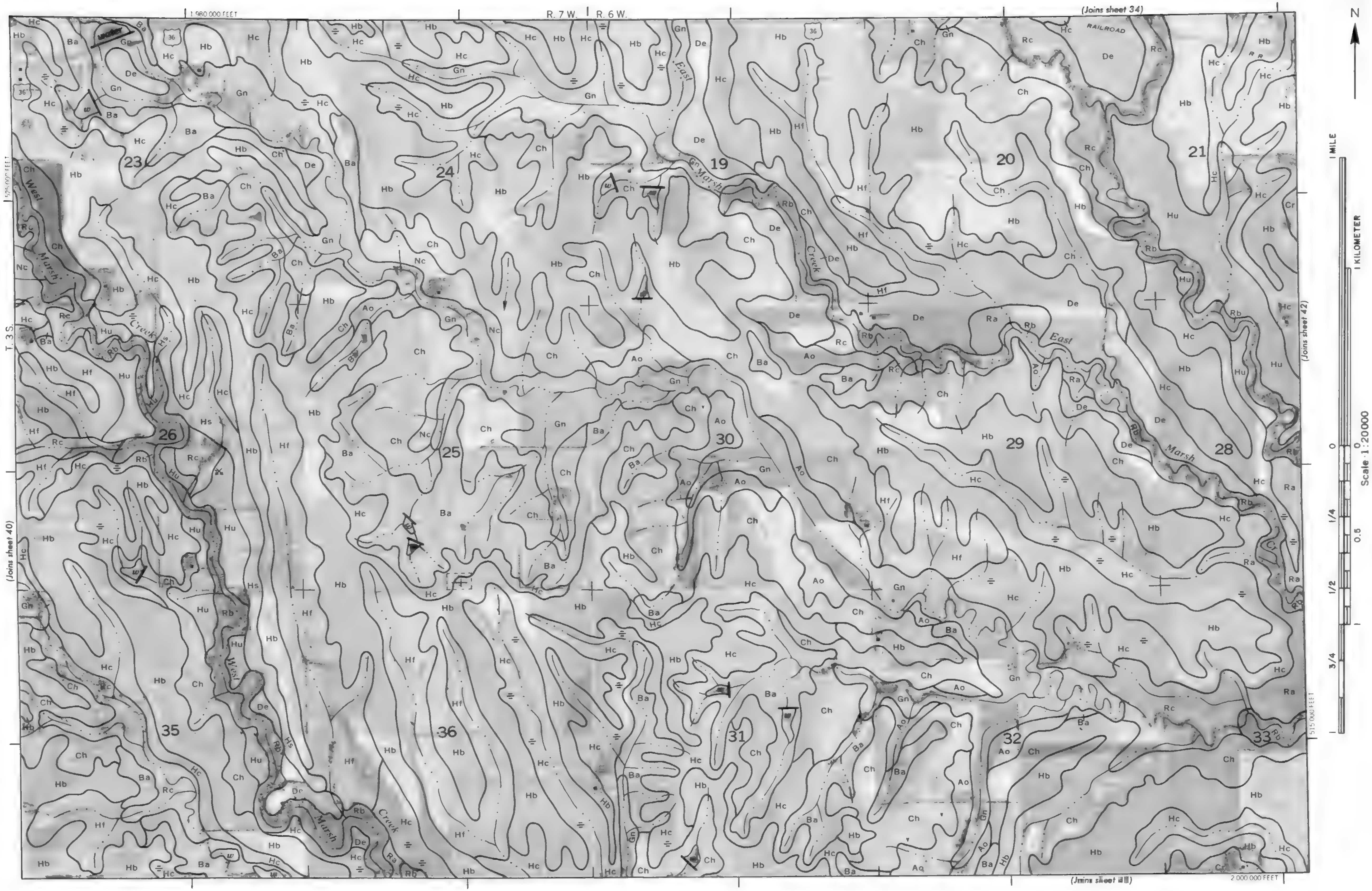
This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 40



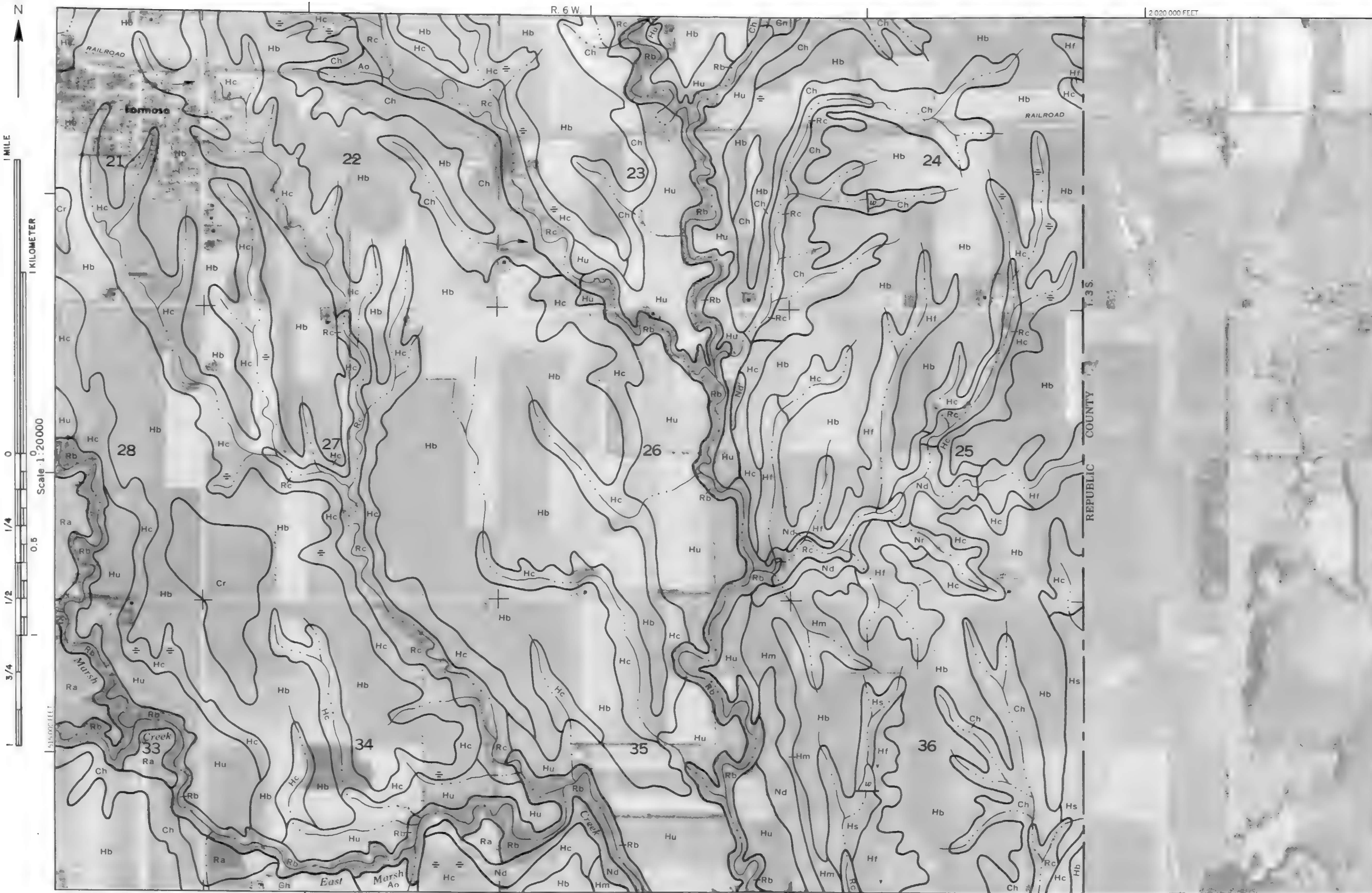
This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 41

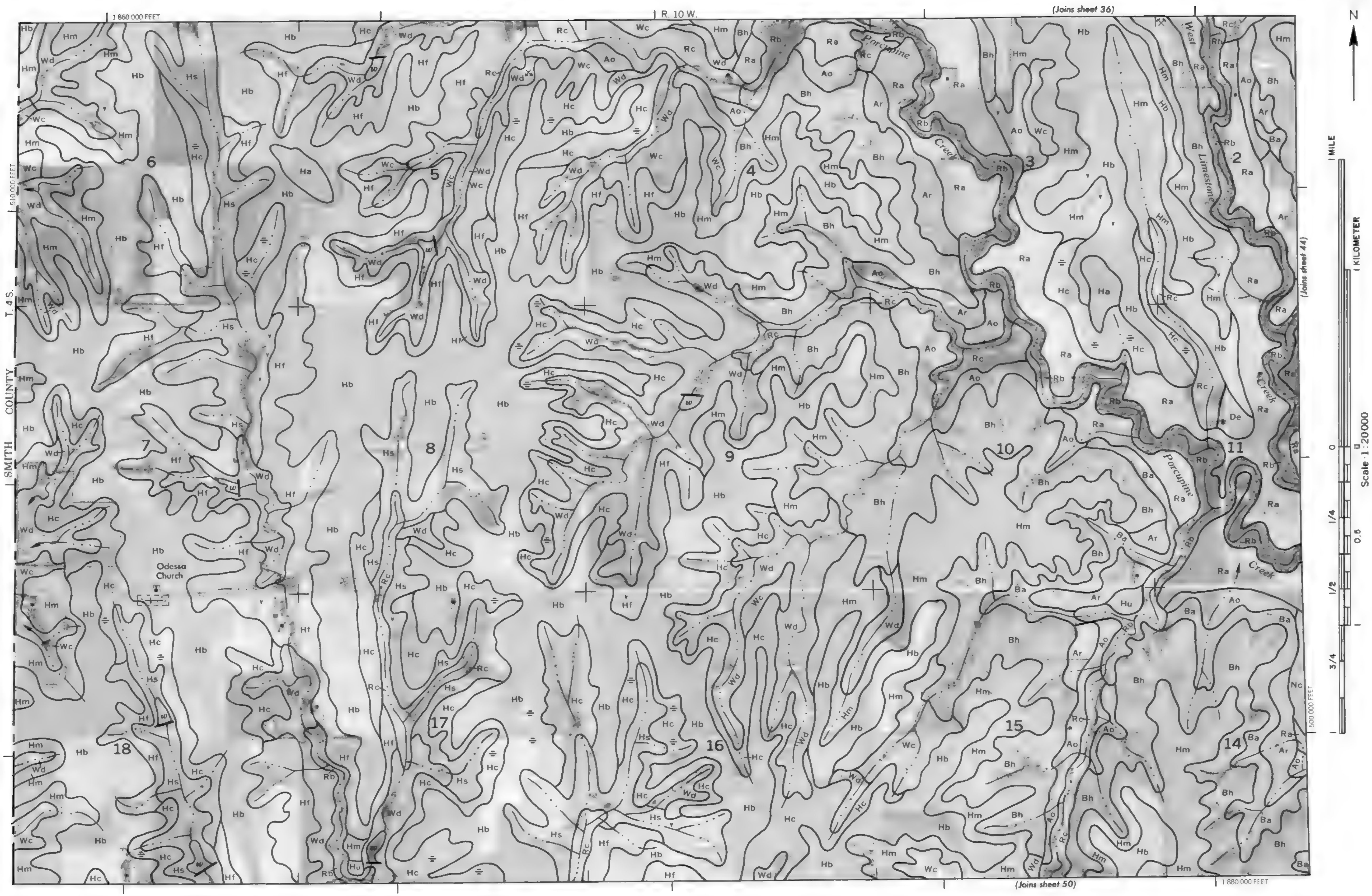


This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

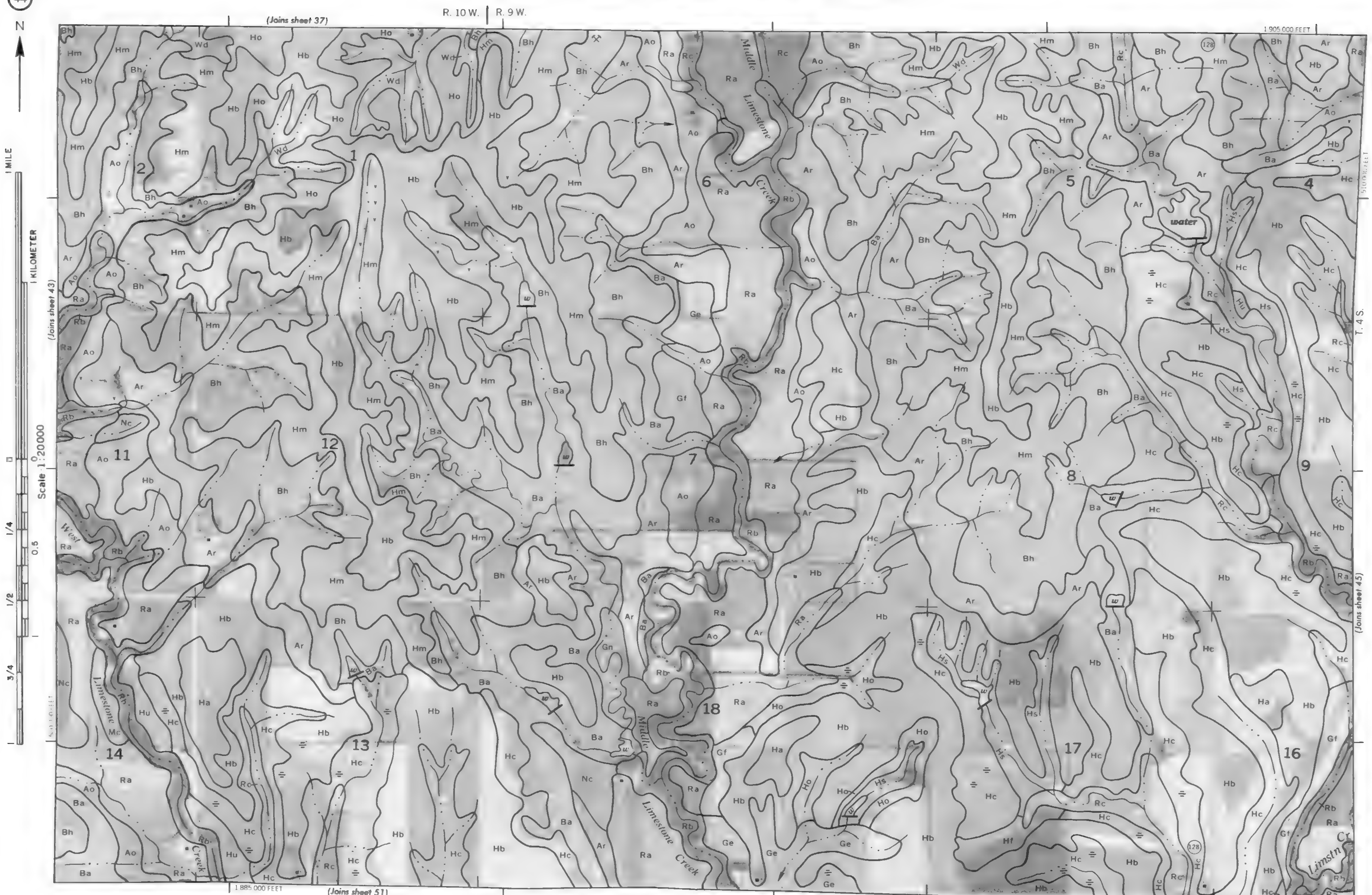
SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 42



This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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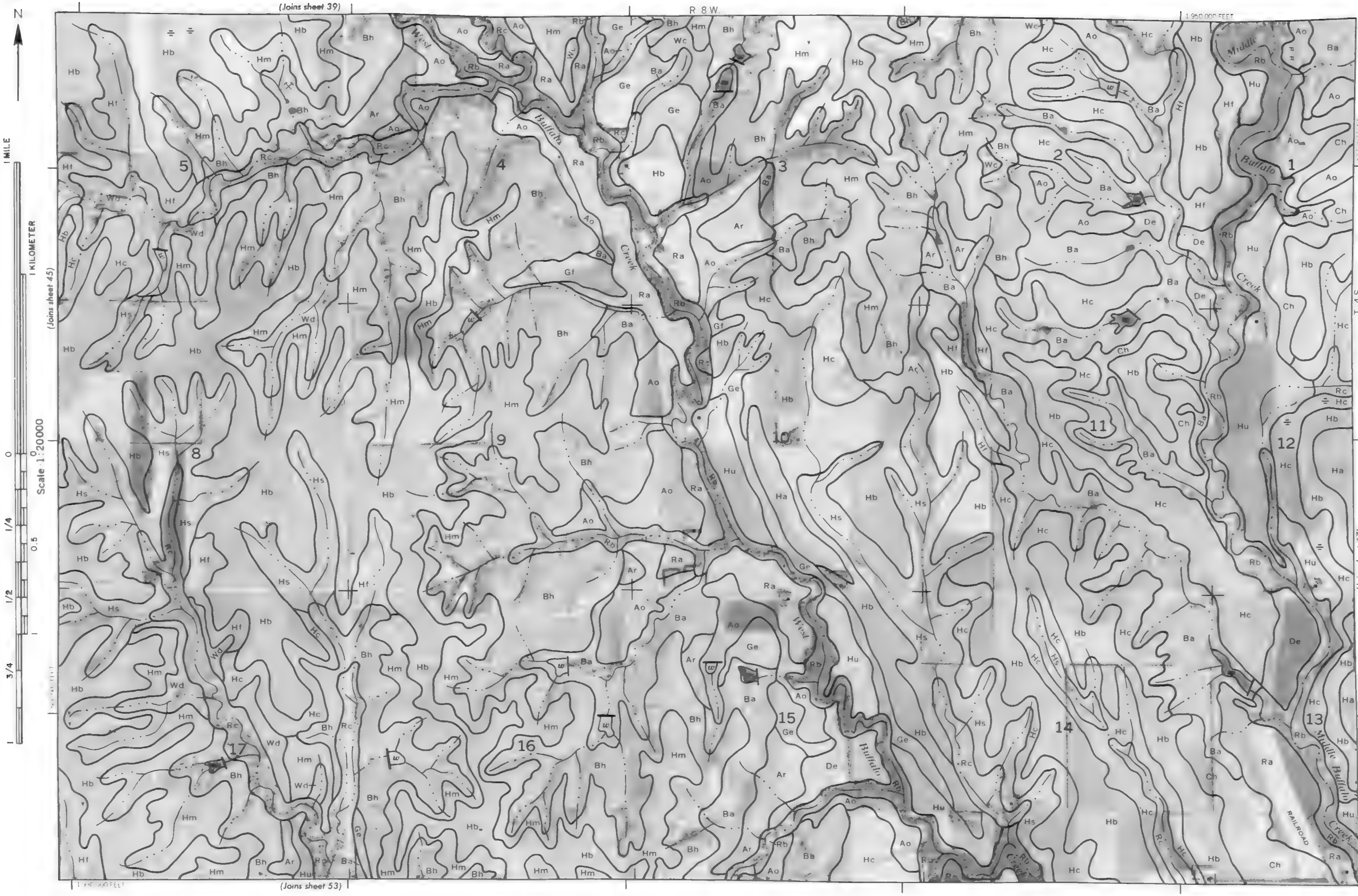
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 46

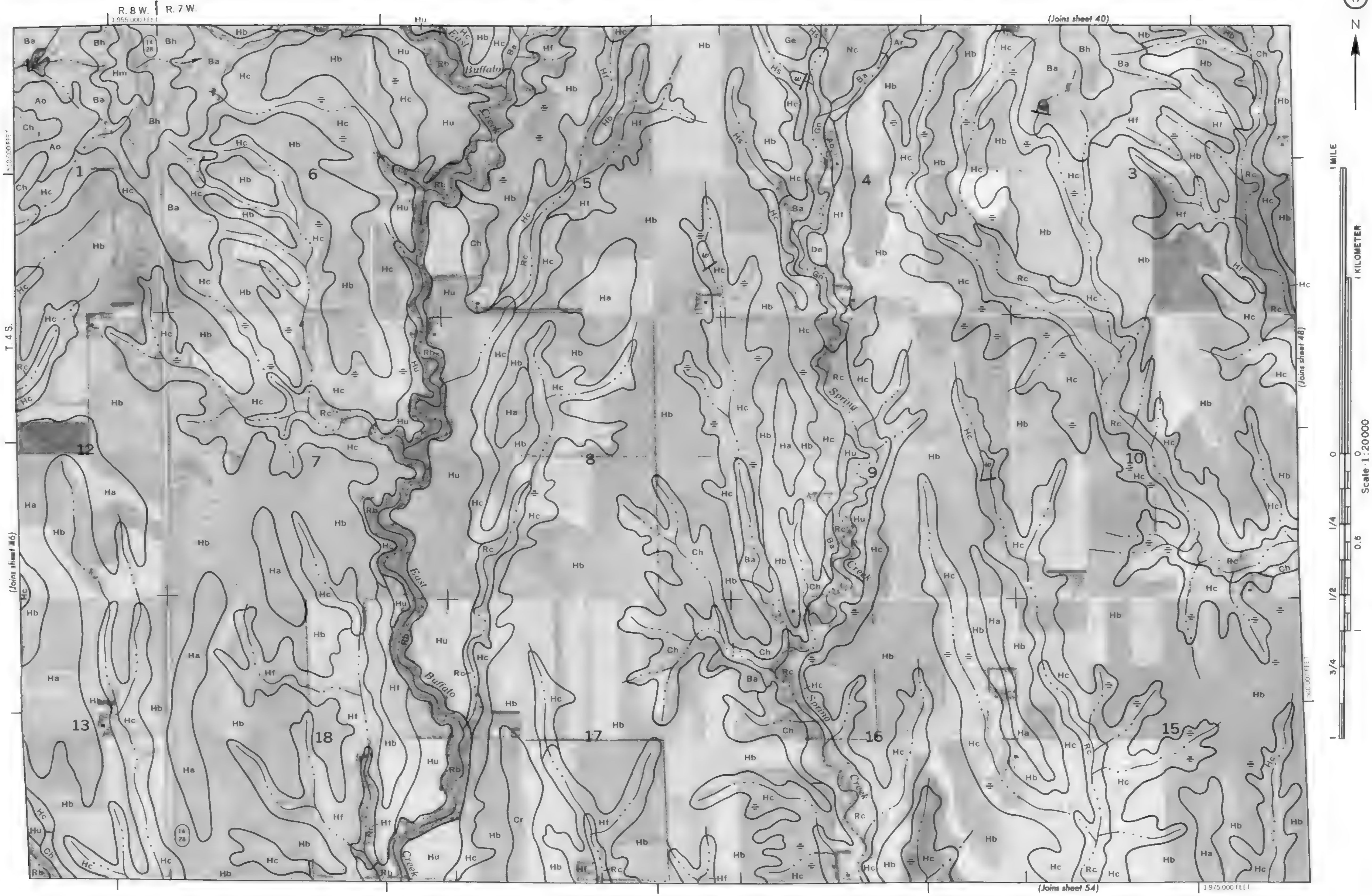


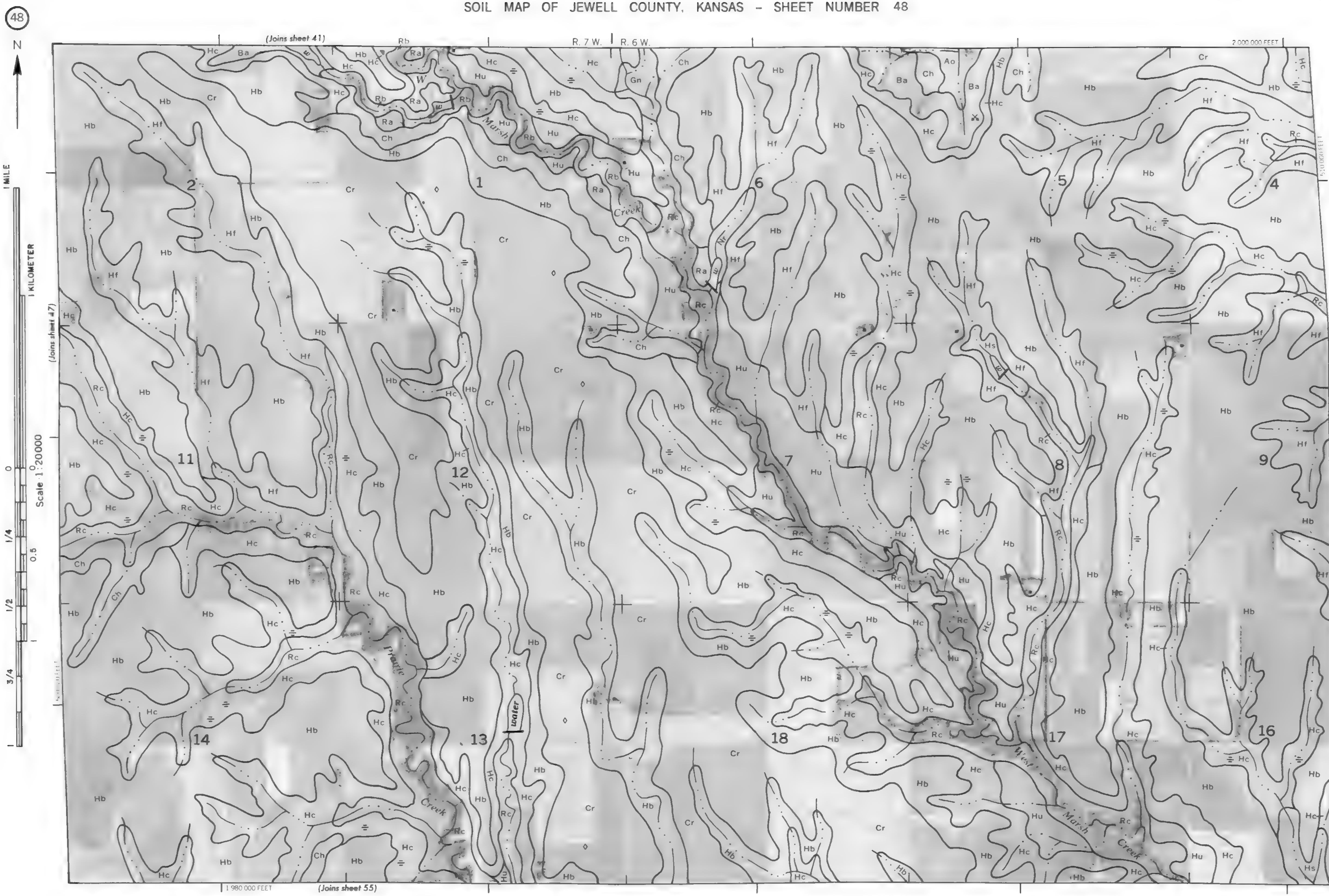
This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 47

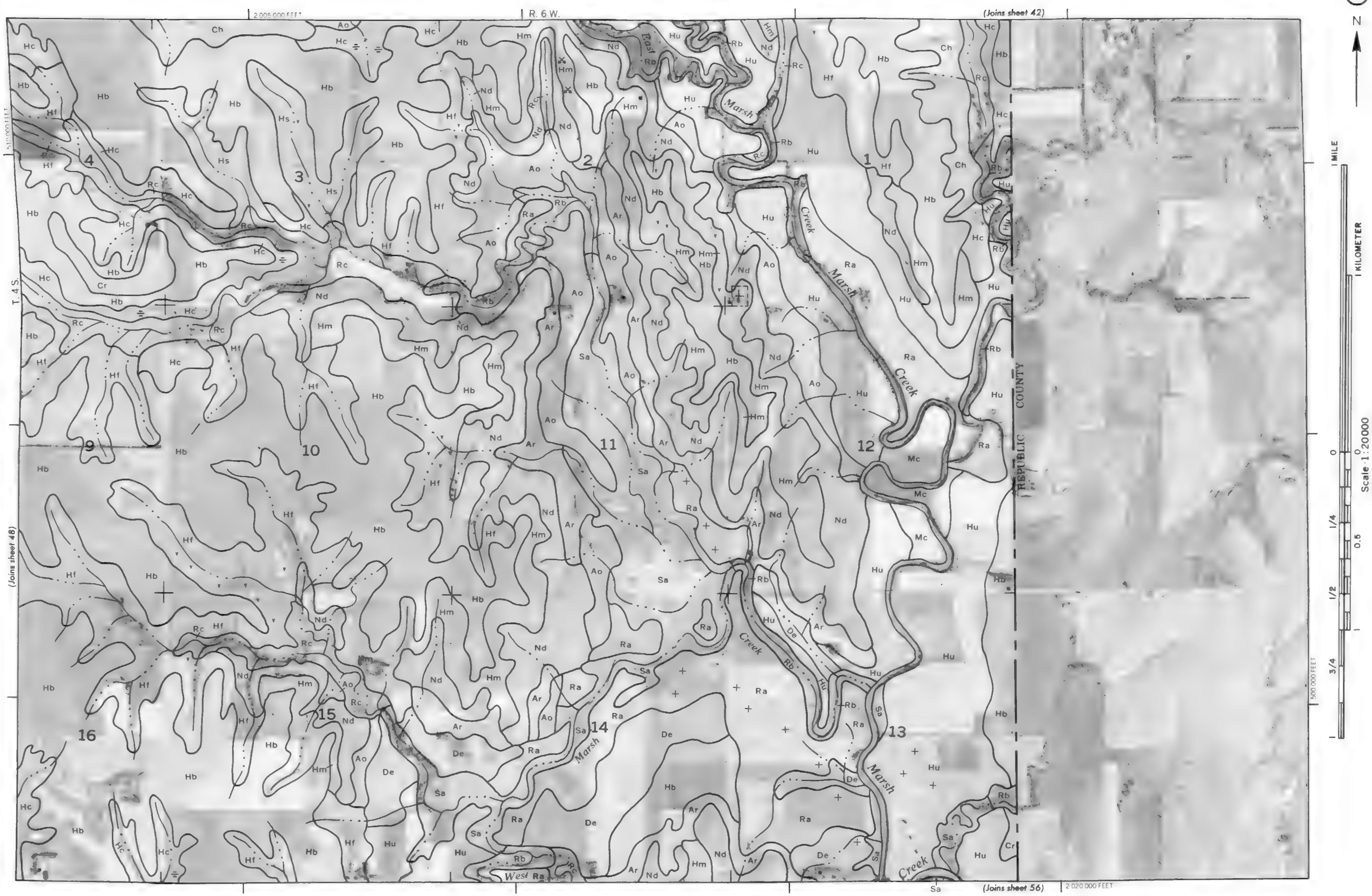
47

This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



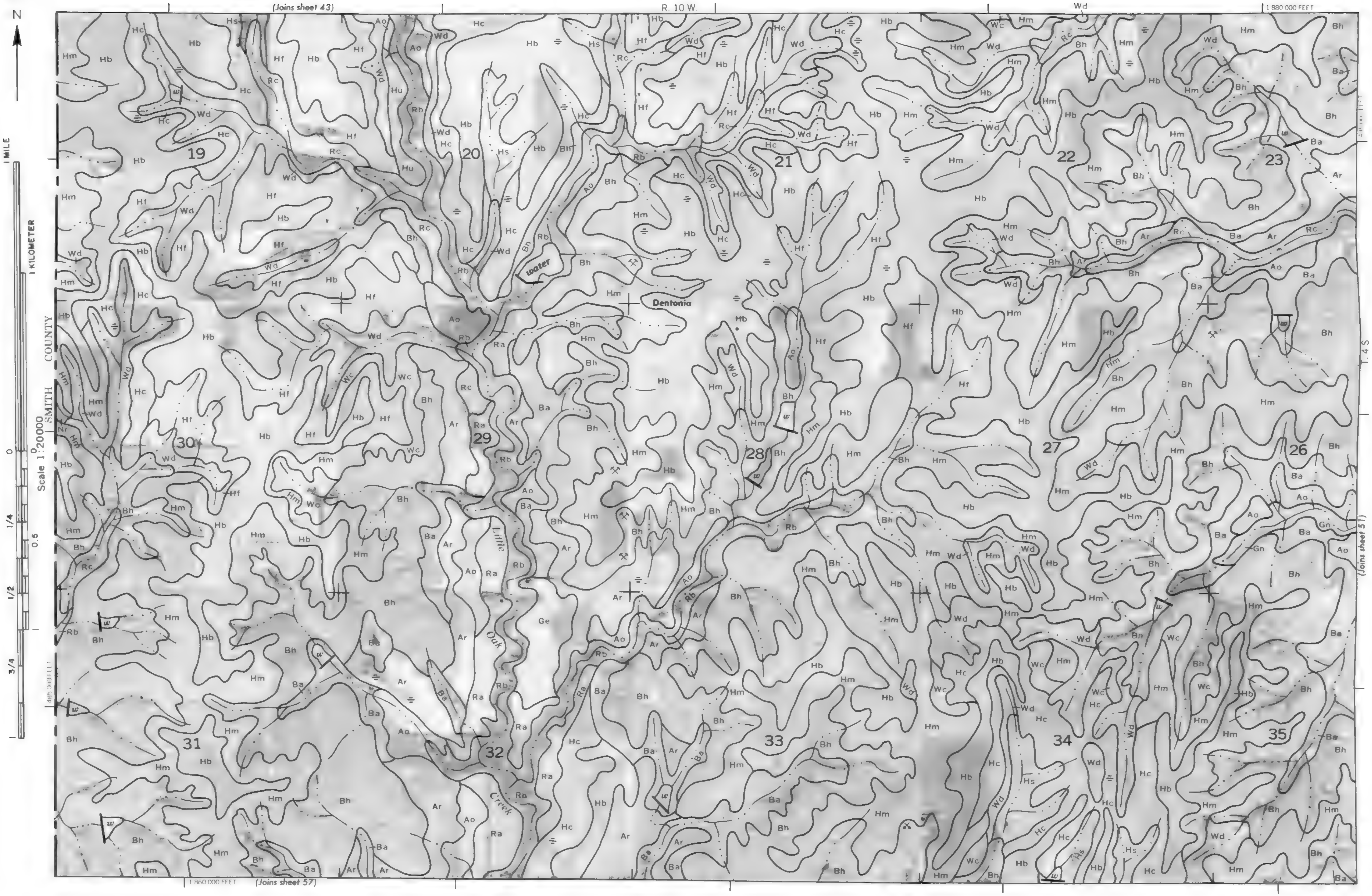


This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



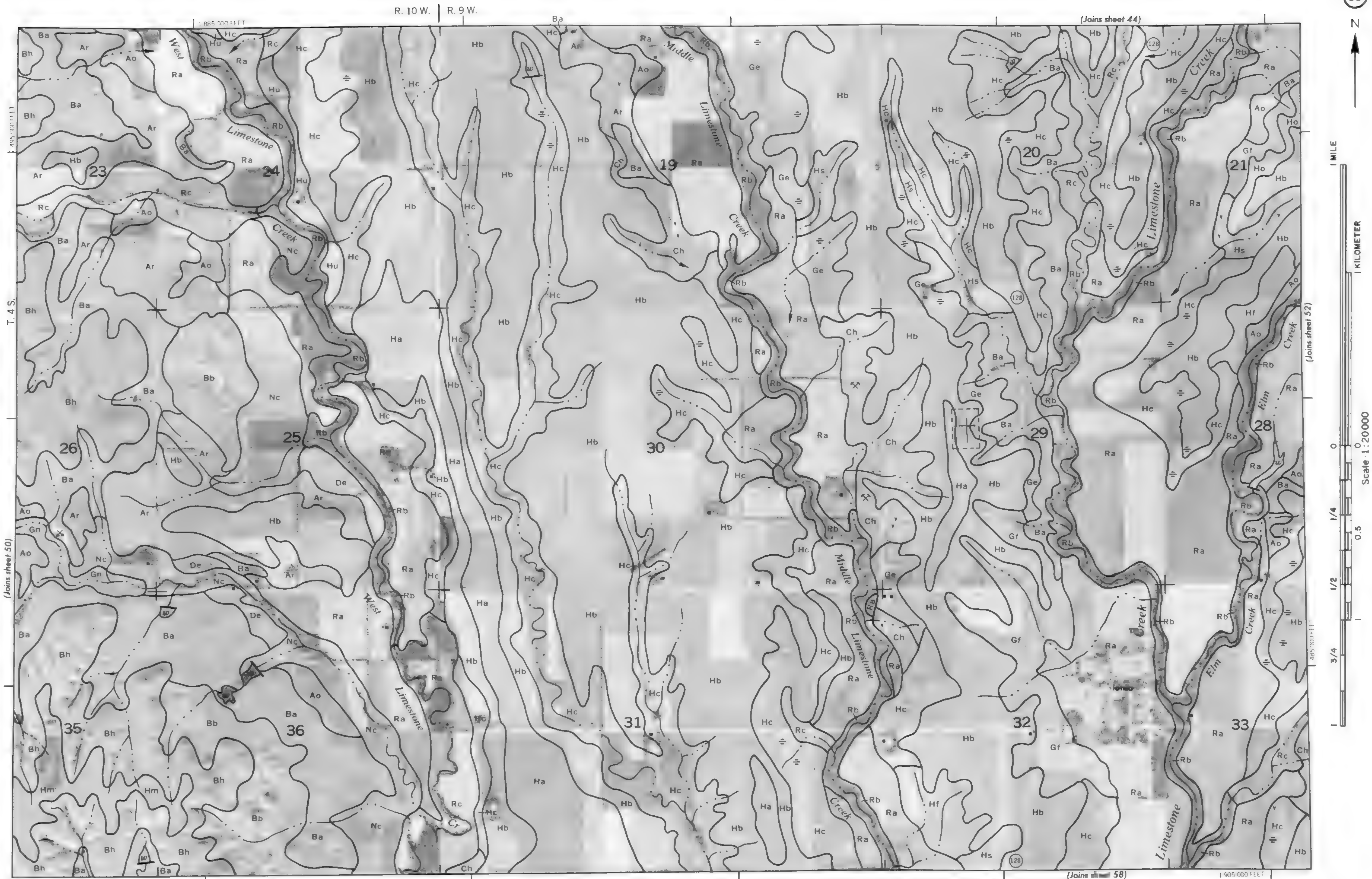
This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 50



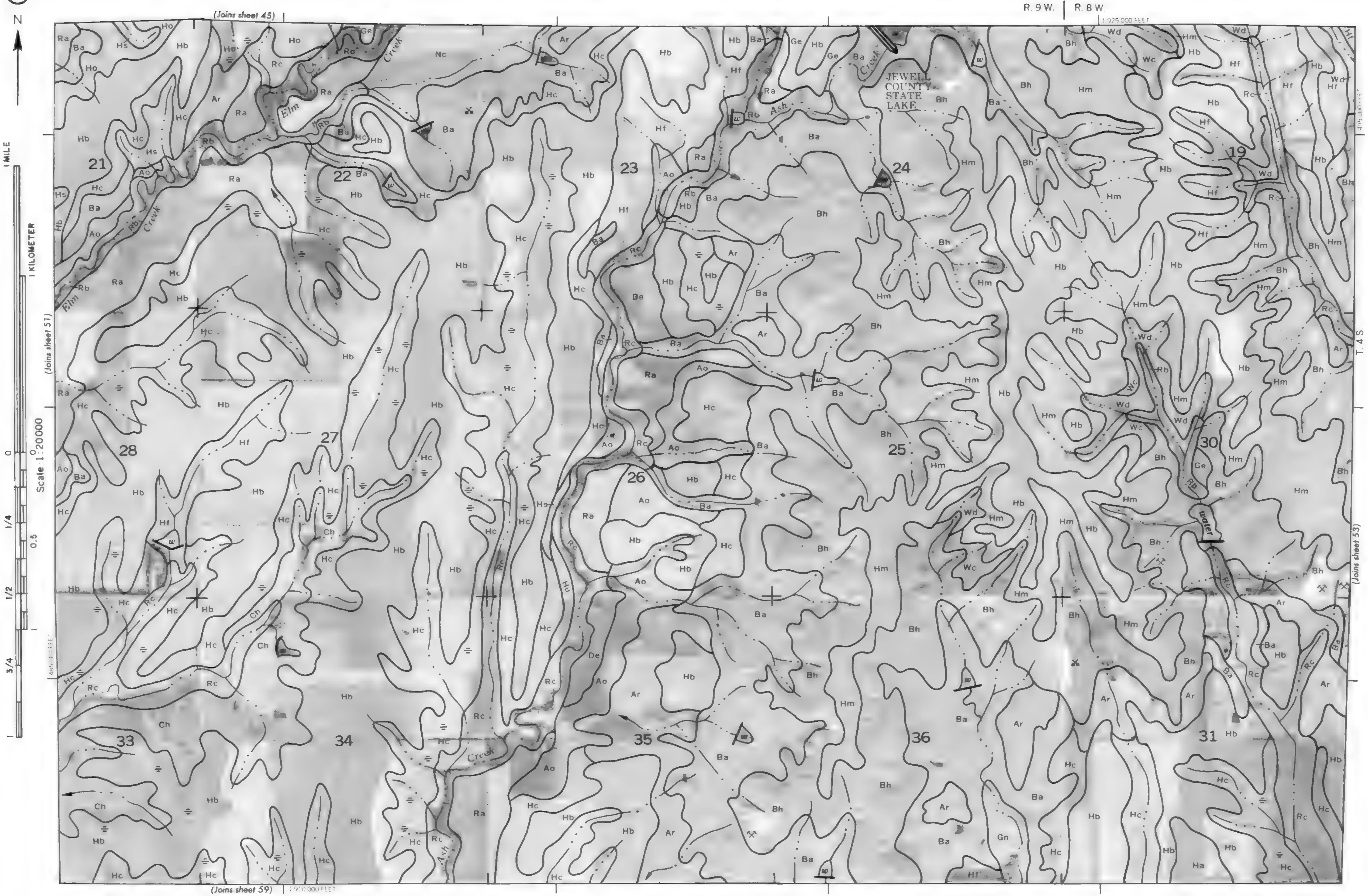
This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 51



This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 52



This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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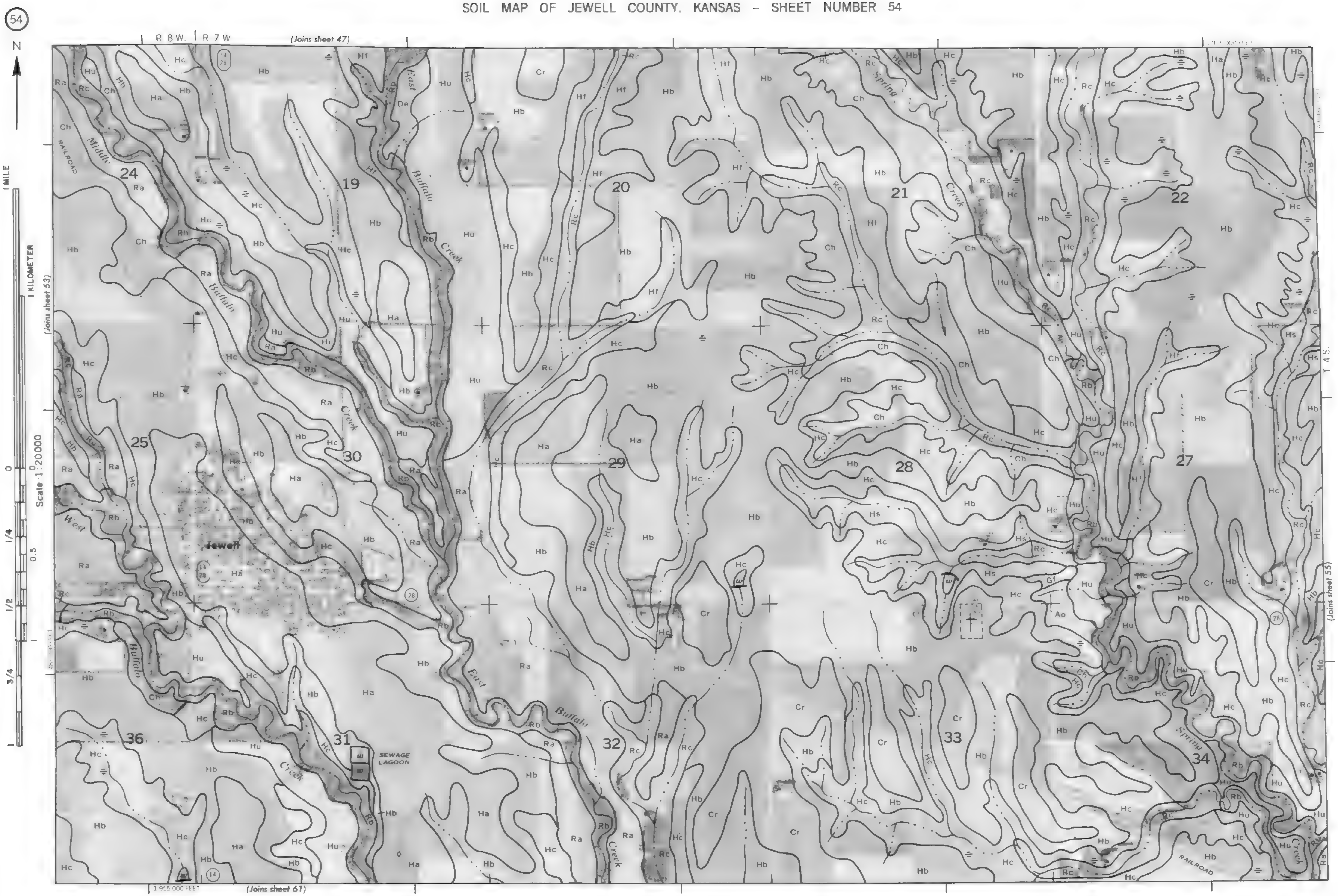
SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 54

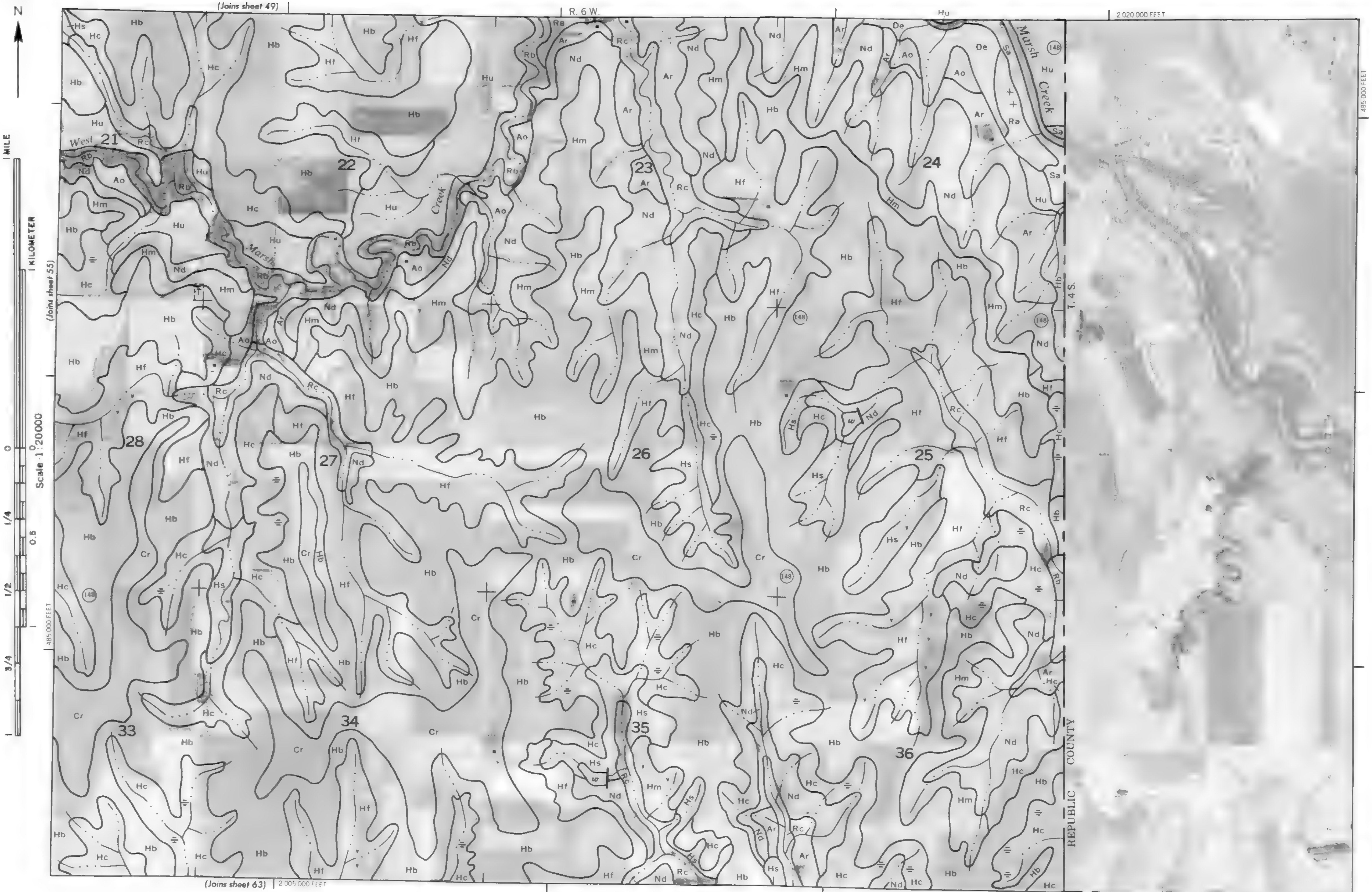


This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 55

This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 56



This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
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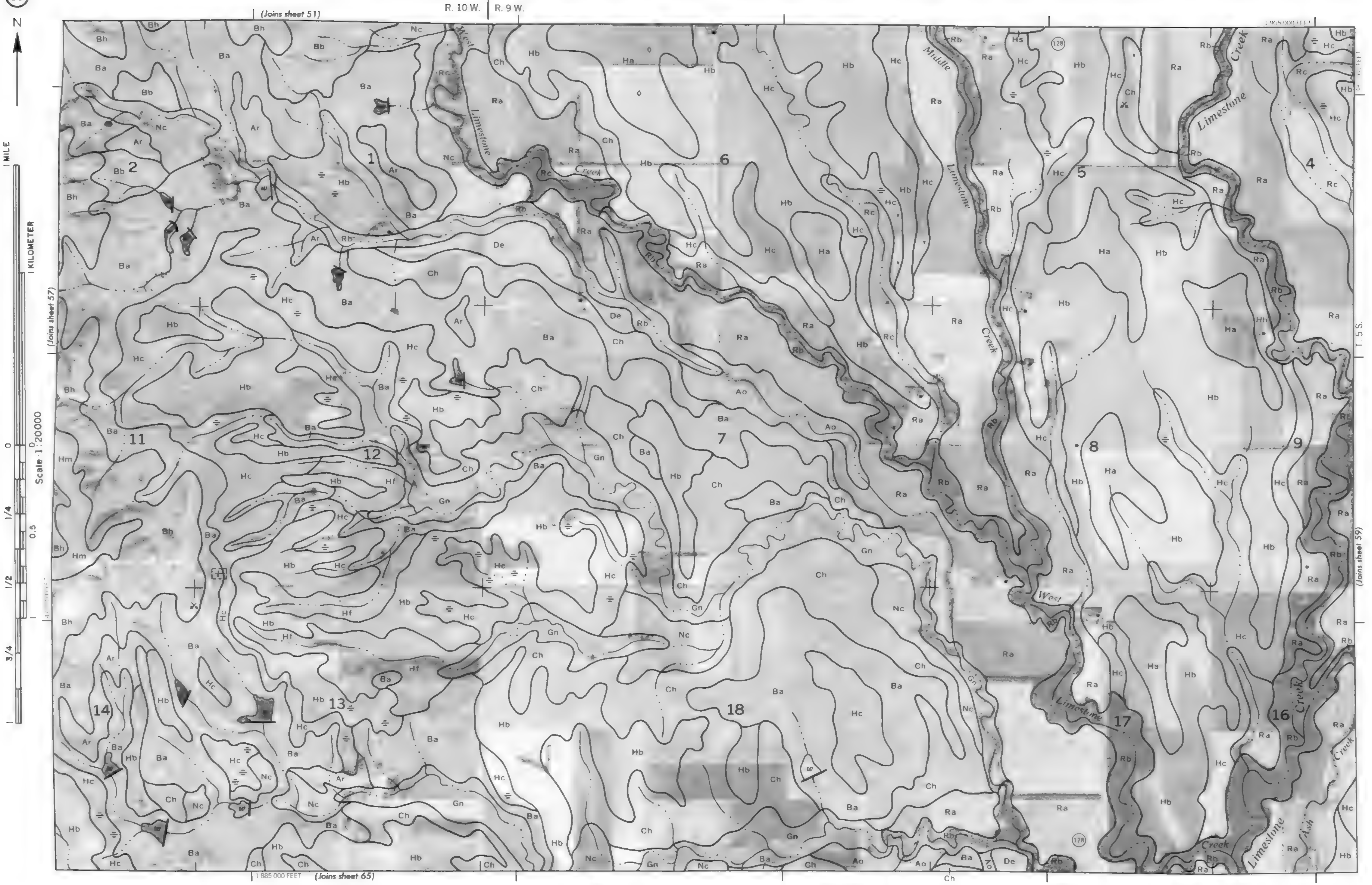
SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 58



This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

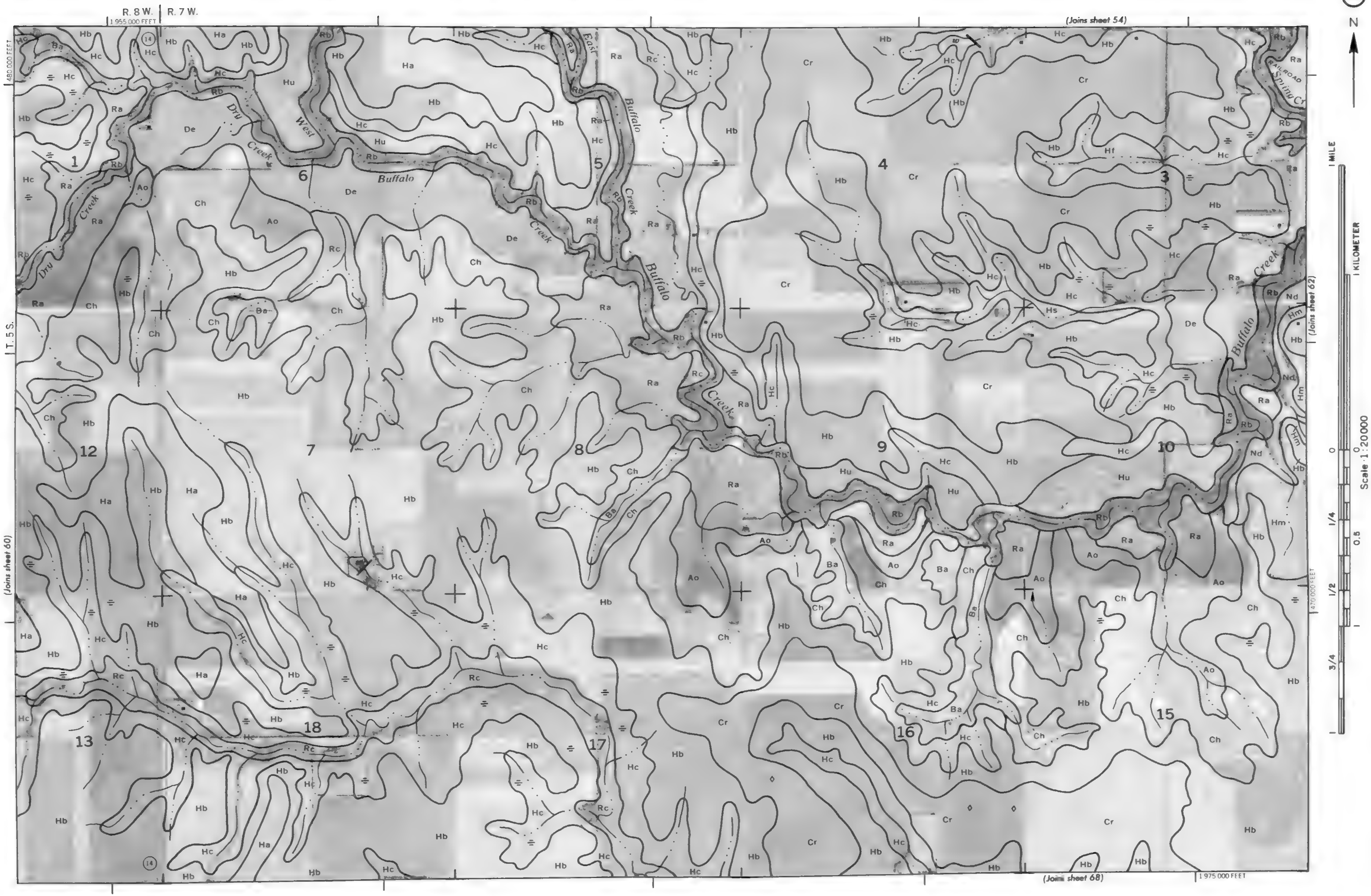
SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 59

This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 60

This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

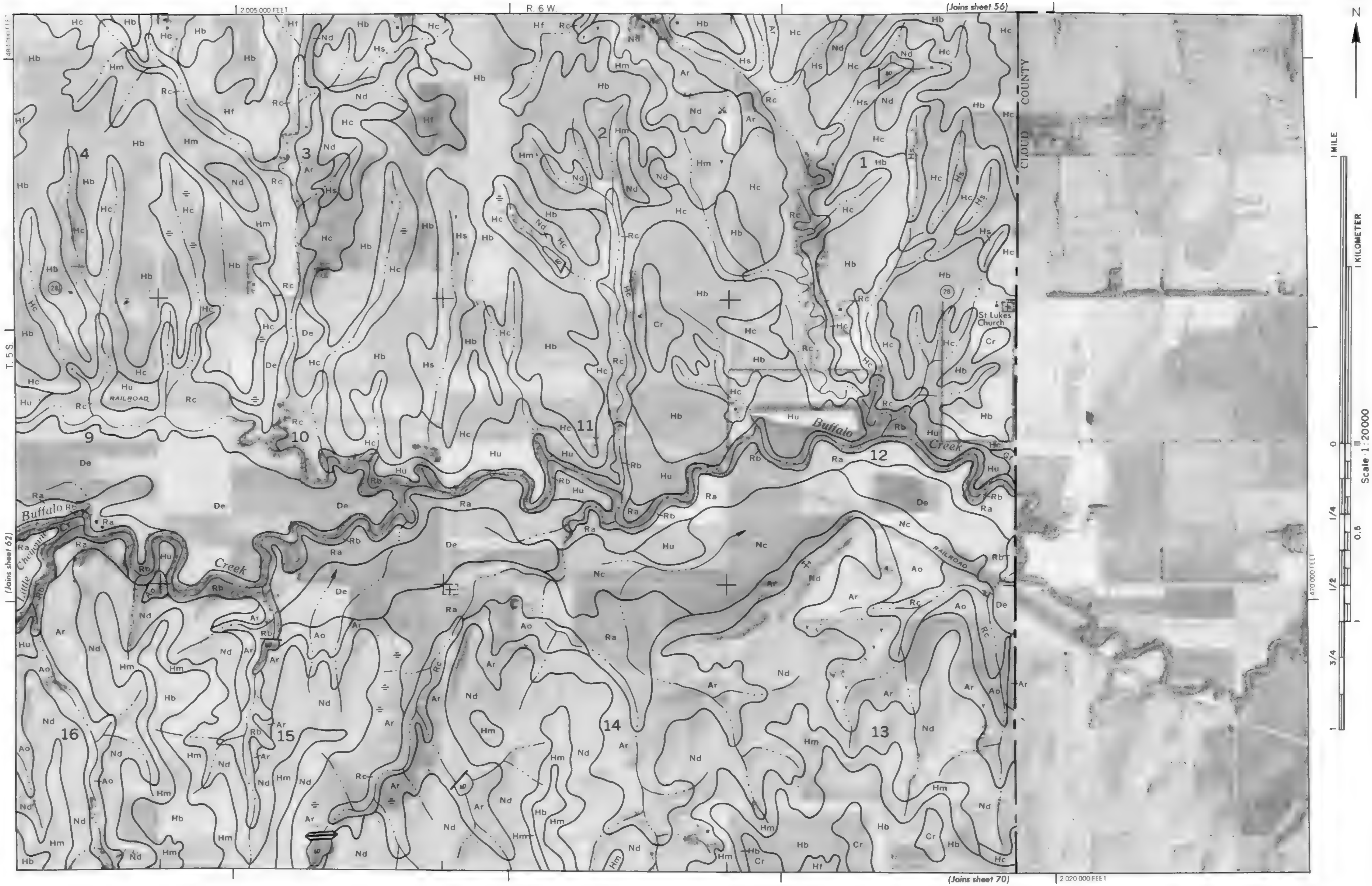
SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 61



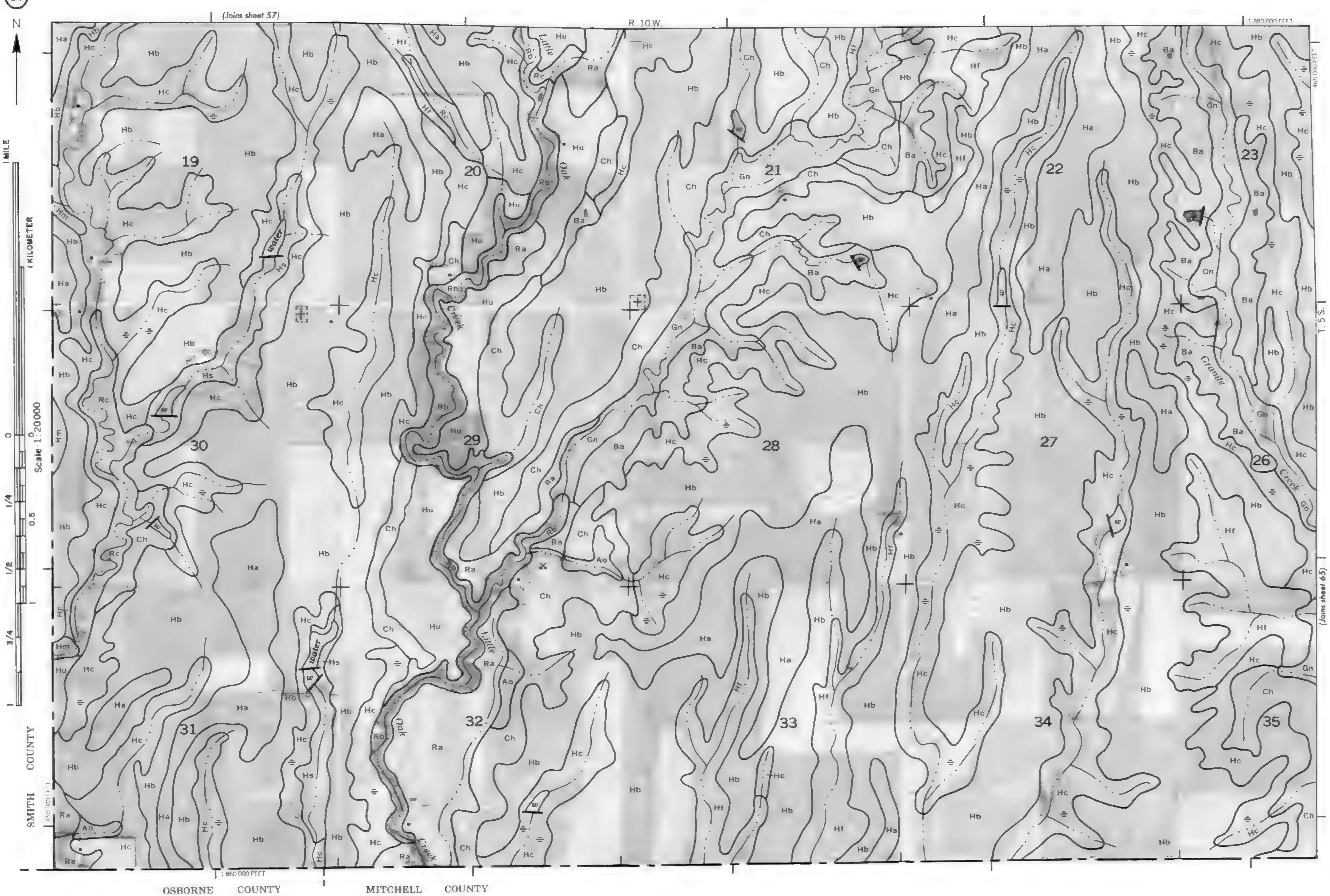
SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 62

This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

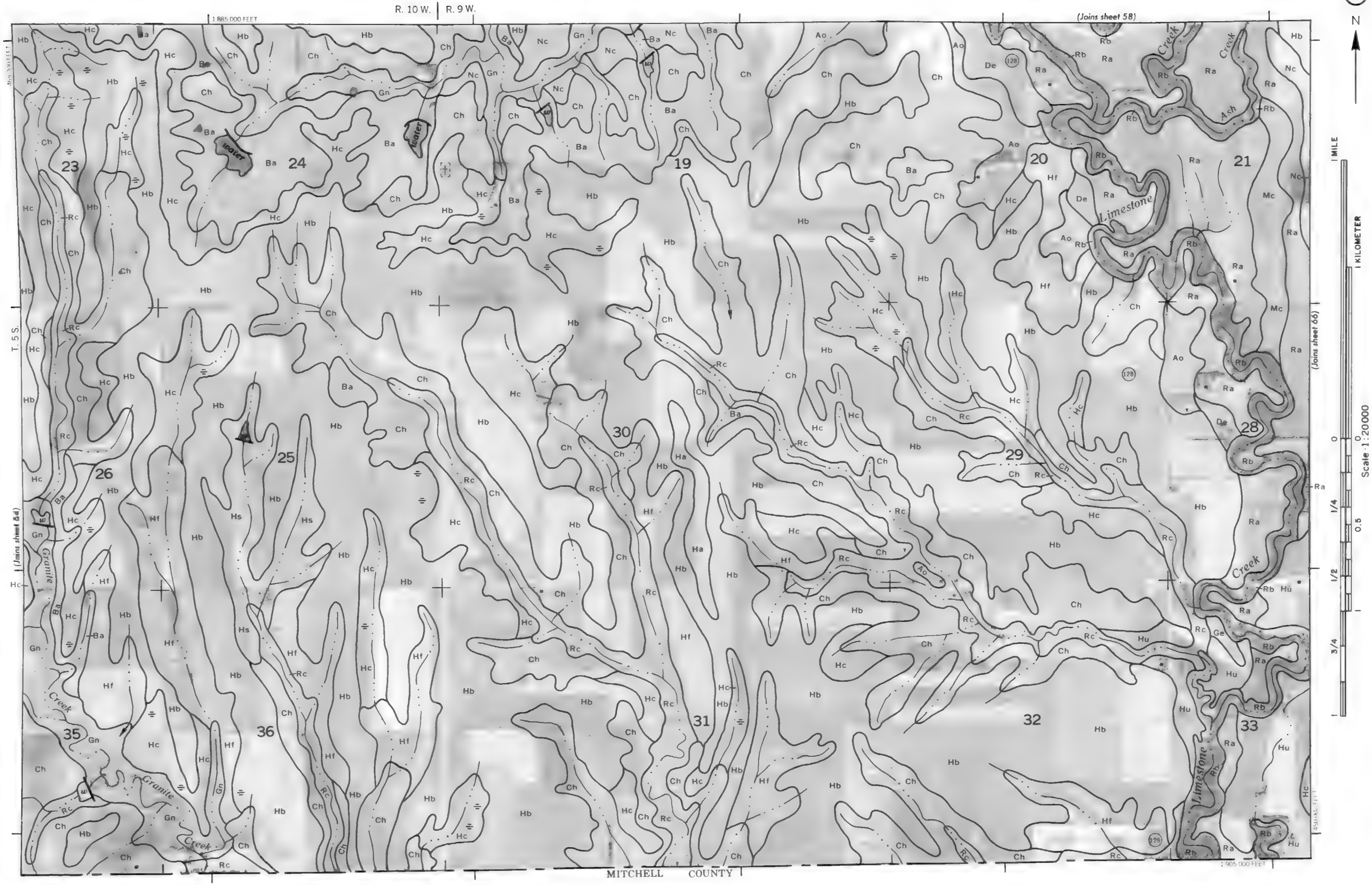
SOIL MAP OF JEWELL COUNTY, KANSAS – SHEET NUMBER 63



SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 64

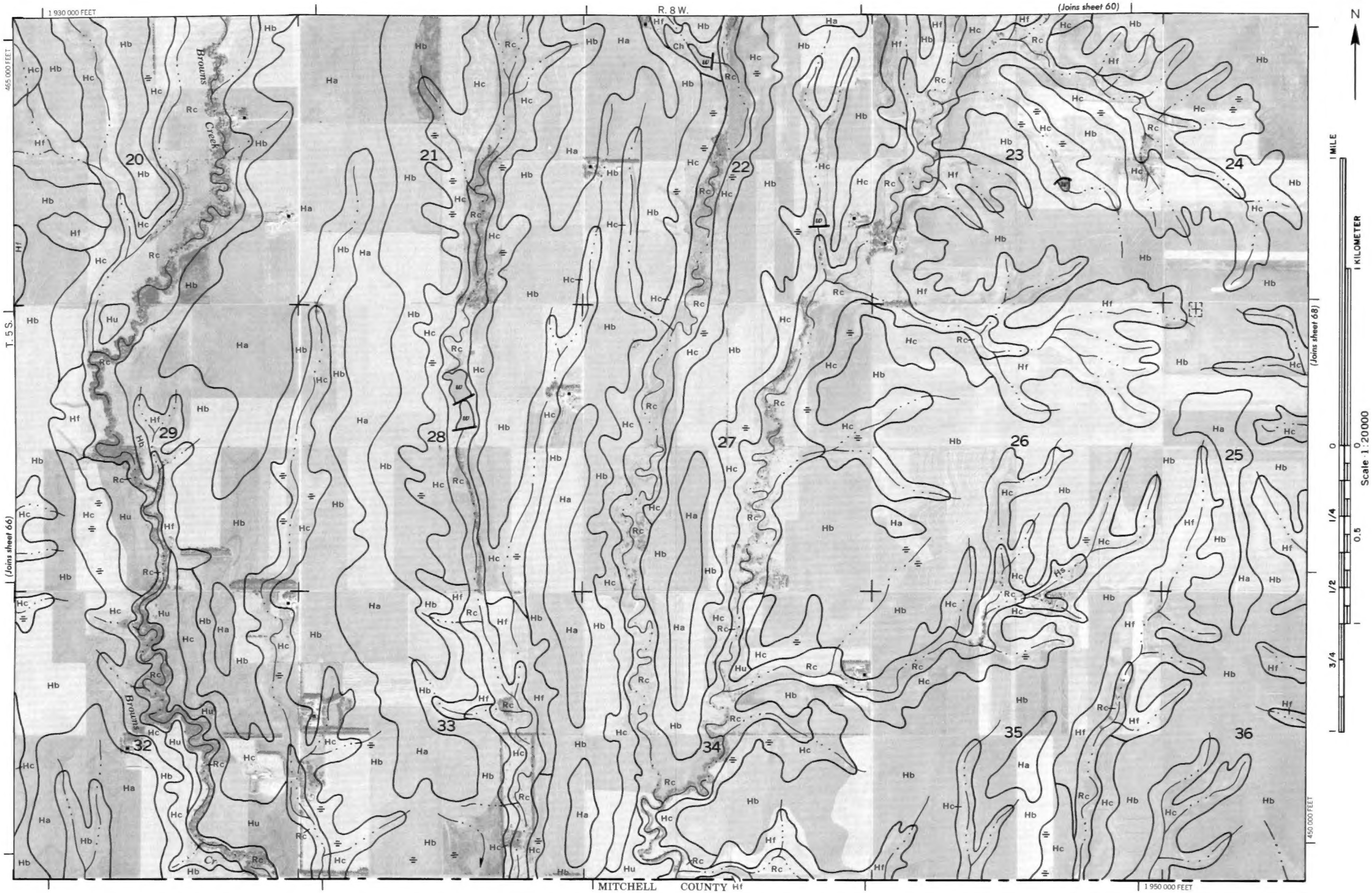


SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 65



This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

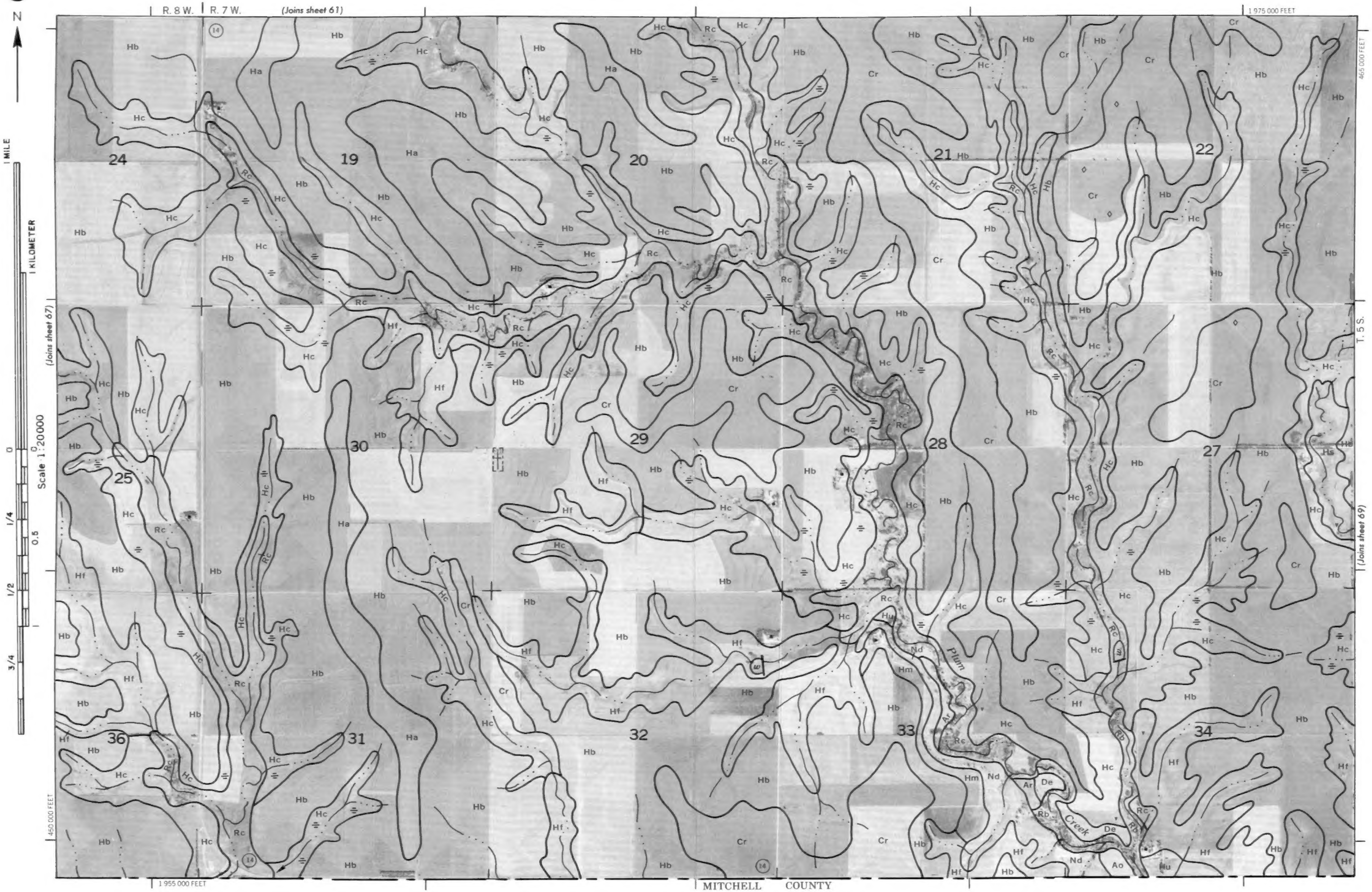
SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 66



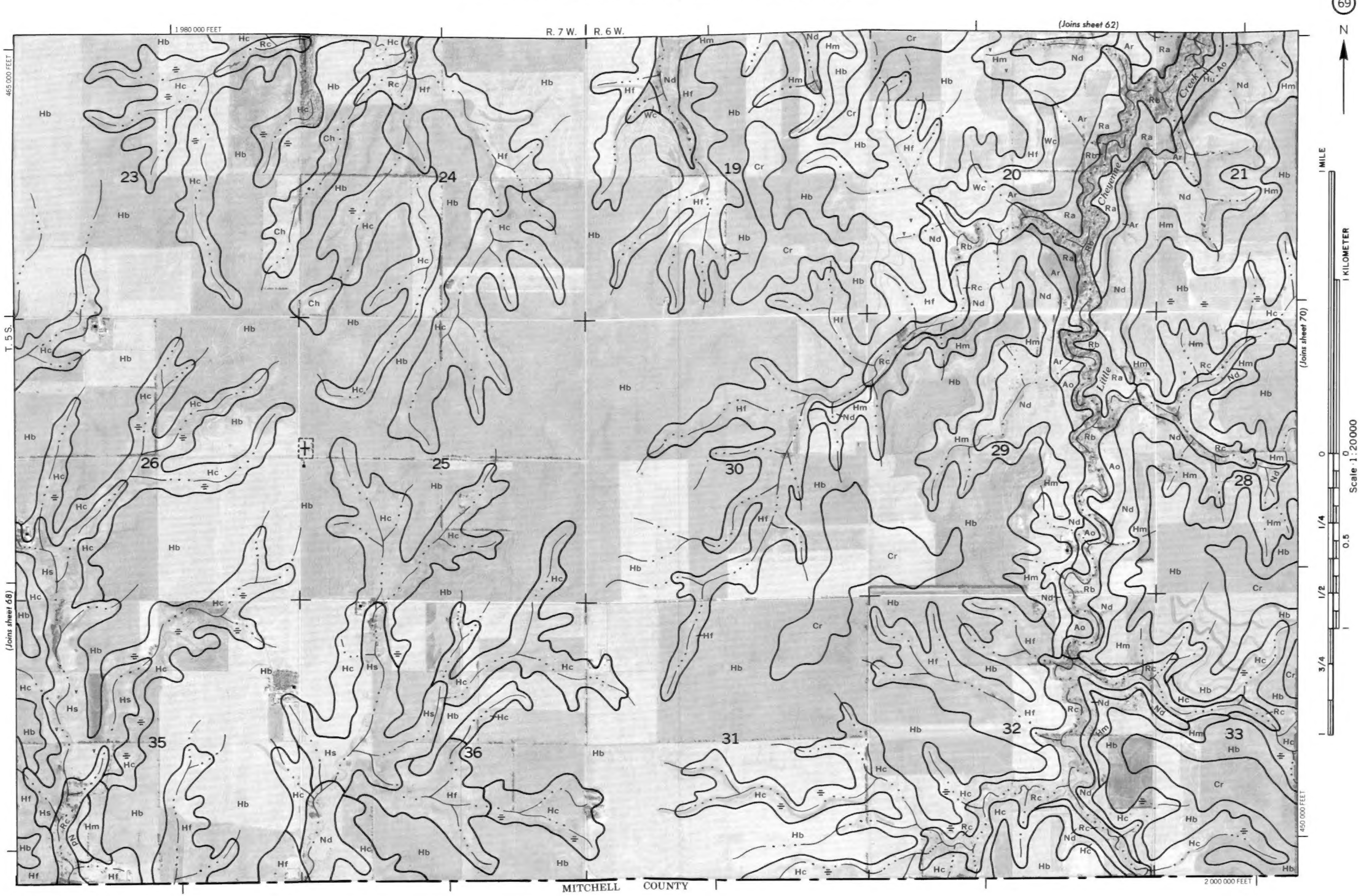
This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

68

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 68

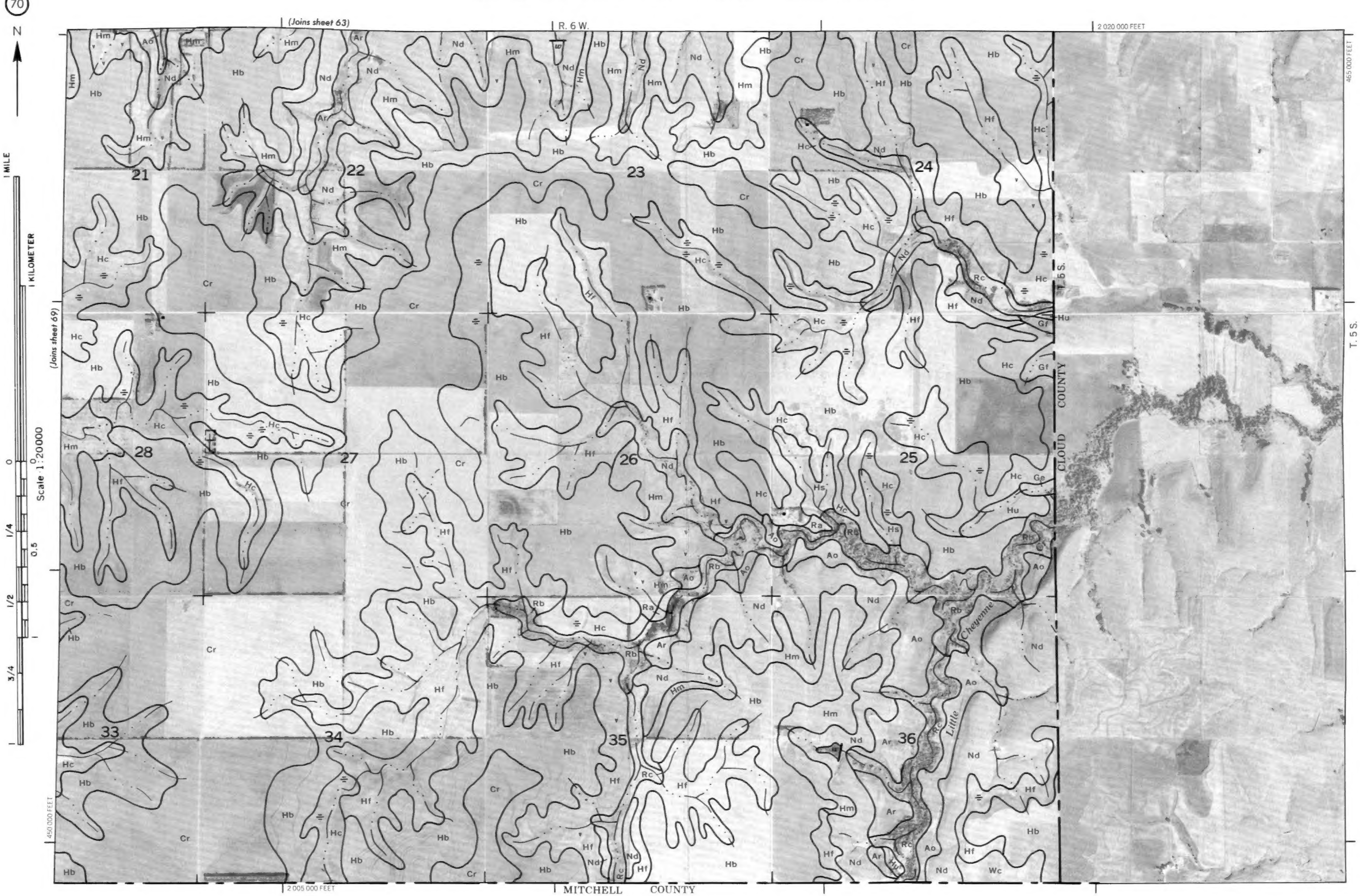


This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF JEWELL COUNTY, KANSAS - SHEET NUMBER 70



This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.